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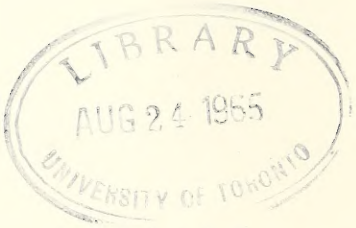

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SURGERY, GYNECOLOGY AND OBSTETRICS

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RESTORATION OF SHOULDER FUNCTION IN CASES OF LOSS OF HEAD AND UPPER PORTION OF HUMERUS

BY FRED H. ALBEE, M.D., SC.D., F.A.C.S., NEW YORK CITY
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THE problem of the dangling limb and the flail joint presented insurmountable difficulties to the plastic surgeon before the day of the bone-graft conception and its general application. Ununited fractures of the long bones, with loss of substance, meant functional incapacity of varying degree, with ultimate shortening and, all too frequently, amputation of the limb itself. Particularly in the case of extensive loss of bone at or near the joints was the situation a hopeless one in respect to any possibility of bone replacement and an ultimate restoration of joint motion and function. Of all surgical conditions, none, perhaps, presented a picture of greater helplessness than a shoulder with a dangling arm from which the upper portion of the humerus was missing.

Cases of loss of the head and upper part of the shaft of the humerus are by no means of infrequent occurrence. Destructive infection (osteomyelitis), or severe crushing accidents may be the cause. Loss of bone may occur through the impact of a projectile, through operative removal necessitated by the degree of mutilation, or on account of new growths (sarcoma, osteitis fibrosa, hæmorrhagic osteomyelitis, etc.). Occasionally congenital absence of the upper end of the humerus has been observed.

Traumata have, no doubt, caused the great majority of these shoulder-joint injuries, and attention has been particularly directed to this group of crippled during the recent war, with its high frequency of wounds of the upper extremities, due to the method of trench-fighting in which the upper portion of the body was exposed. The occurrence of these cases in our recent military experience was especially emphasized by an eminent surgeon of l'Hôpital Militaire Complémentaire, at Ris-Orangis, who, upon the author's arrival in 1916, remarked:

"The cases which are most disturbing are those unfortunate ones with loss of the upper portion of the humerus."

From the standpoint of *definitive treatment*, such cases had indeed been previously regarded as quite hopeless. The arm was merely a cumbersome appendage which might, occasionally, be swung laboriously from one side to the other in the performance of simple, clumsy acts, but which, from a practical standpoint, was useless. Shortening invariably occurred through lack of skeletal support, with muscular weakness from disuse resulting from the unfavorable mechanical conditions. Cases of loss of the upper portion of the humerus in the growing individual have been observed in which the arm became shortened to a remarkable degree; in rare instances, the upper end of the humeral fragment has been known to come in contact with the acromion process, whereby a considerable

Fig. 1. Case 1. Roentgenogram of left humerus, showing extensive osteosarcoma which necessitated operative removal of more than 4 inches (11 centimeters) of the upper portion of the bone, including the head.

amount of voluntary motion resulted. In the majority of cases, however, little, or no practical use was to be had of the disabled member; and in severe cases amputation of the entire limb was often considered necessary.

The only solution of this hitherto insurmountable problem, which involves loss of function of one of the most important joints of the body, lies in the replacement of the bone which is missing. The constant and normal length of the upper arm is maintained entirely by its mechanical framework, the humerus, upon which is based the physiological action of the muscles and tendons. When normal conditions cease to exist, the function from the leverage-action of the bony skeleton, actuated by muscle-pull, diminishes accordingly, even to complete absence.

The bone graft fulfills the requirements in this problem of restoration of skeletal support. Theoretically, by its use, the loss of bony substance may be restored, thereby supplying the necessary, normal mechanical framework, over which the muscles and tendons may work once more. Practically, however, these cases of restoration of shoulder-joint motion and function present individual problems depending upon the condition of the shoulder musculature, as well as the actual loss of bone. Not infrequently is extensive bone loss associated with destruction of muscles, and the problem, thus, becomes not only one of restoring the continuity of the scapulohumeral joint, but of devising some means of recovering lost function of the shoulder.

Cases of loss of head and upper portion of the humerus have been classified by the author in two groups, with respect to surgical treatment. This classification is based upon the condition of the shoulder musculature. Group I includes those cases in which the muscles have not been injured to such extent as to rule out any possibility of obtaining a *movable, functioning, reconstructed shoulder-joint.* It is the author's custom in cases of this type to restore the humeral loss by the head and upper portion of the patient's fibula. To Group II are assigned the cases in which the damage to the shoulder muscles has been so severe (from laceration, destructive infection, etc.) that restoration of function and joint motion at the shoulder is impossible.

Group I is divided into two classes of cases, according to the degree of injury to the musculature: Sub-group A contains those cases in which the muscles of the shoulder are practically uninjured, and, in fact, have been so far preserved as to allow their separation, dissection, and individual insertion upon the bone (usually the fibula) which is used to restore the humeral loss. This type of case is the most favorable of all in respect to restoration, and will be illustrated by Case 1, of the author's series, about to be described. Sub-group B comprises those cases of loss of upper humerus in which the shoulder-musculature is sufficiently preserved to warrant the reconstruction of the joint, but in which it is impossible to make an individual separation. In these cases, therefore, it is usually necessary to attach the muscles *en masse* to the bone which is used to restore the humerus.

The cases in Group II offer the greatest difficulty in the work of surgical reconstruction, for in this class the musculature has been so far destroyed as to render impossible any hope of restoring shoulder-joint motion. Serious damage of the musculature has followed gunshot injuries, with loss of muscle resulting either primarily from the passage of the projectile, with or without associated extensive infection, or from subsequent surgical removal. The muscle loss may also be through destruction by infection, or in crushing from accidents, or due, in certain rare instances, to extensive removal of soft parts on account of a neoplasm.

The controlling feature in the treatment of this type of case (Group II) consists in *securing a posture of the humerus and upper extremity in relation to the scapula, by an arthrodesis of the shoulder-joint, which brings about a compensatory function by the scapulothoracic motion to replace function by shoulder-joint motion which has been lost.* The essentials of this posture are as follows: With the scapula in a neutral position, namely, flat against the chest-wall, the humerus is elevated anteriorly at right angles to the trunk, and in a degree of rotation which brings the hand in front of the face, as shown in Figure 20, Case 4. The humerus is arthrodesed to the scapula by a truss-work of tibial grafts. With the arm immobilized by a plaster-of-Paris shoulder spica in this position in relation to the scapula, the powerful scapulothoracic muscles are later able to control it with an unexpected degree of efficiency, and the hand may be brought with great readiness to the neck-tie, mouth, or hair, functions impossible to perform when there is lack of control of the upper extremity at the shoulder.

TECHNIQUE IN ILLUSTRATIVE CASES

The most favorable condition met in shoulder cases of the foregoing types is illustrated by Case 1, of the author's series. In this case (which belongs to Sub-group A of Group I), the shoulder musculature was practically uninjured, and it was possible, after replacement of the lost bone, to re-attach the shoulder muscles in their proper relationships. The technique employed was typical of shoulder cases of this group. The history of the case is given as follows:

Fig. 2. Case 1. Showing a patient in the dorsal position on the author's fracture-orthopedic table. In fractures of the upper portion of the humerus, with or without loss of bone substance, position of the extremity during operation and the subsequent application of the plaster cast is most important.

Case 1. Mrs. G., a housewife, age 25, was referred to the author by her physician, George H. Sexsmith for a tumor involving the upper portion of the left humerus. The patient had suffered from a dull, drawing pain in the left shoulder, which had persisted with increasing severity for more than 10 months. The condition was previously diagnosed by several physicians as rheumatism, and treated by various medicaments, without success. Use of the violet-ray had likewise afforded no relief, and after the eighth treatment, examination by the roentgen-ray revealed a tumor on the upper third of the left humerus, which had destroyed a portion of the shaft.

Examination of the patient showed the general physical condition to be good, with but slight loss in body-weight. Pain in the left shoulder, however, was constant, and, upon moving the arm, became sharp and stabbing. Nocturnal pains were especially emphasized. From the clinical course of the case

Fig. 3. Case 1. Important steps in the technique of removal of the head and upper portion of the left humerus for extensive osteosarcoma and replacement by the head and upper end of left fibula.

a. Exposure of the sarcoma involving upper portion of humeral shaft.

b. Removal of the upper humeral fragment containing the tumor.

c and *d*. Securing head and upper end of fibula which is to replace the fragment of humerus just removed. In *c* the upper end of the fibula is shown exposed; the external popliteal nerve has been laid bare and retracted laterally by means of gauze tape, in order to avoid injury to it; and the shaft of the fibula is being severed with the Gigli saw. With the Lambotti clamp, the lower end of this fragment is elevated (see *d*), while the head of the fibula is separated from the tibia by severing the tibiofibular joint capsule and the overlying periosseous structures.

e and *f*. Replacement of head and upper portion of humerus by fibula transplant.

and the roentgenographic findings (see Fig. 1), the condition was diagnosed by the author as osteosarcoma. Operative removal was recommended and performed 2 days later, June 4, 1919.

The operation consisted in the resection of the head and upper end of the shaft of the left humerus, and replacement by the head and about 4 inches of the shaft of the patient's left fibula.

Technique. With the patient in the dorsal position upon the author's fracture-orthopedic table, the left arm was elevated at right angles to the trunk, in the posture shown in Figure 2. Sufficient traction was applied to hold the limb stable, and the arm was maintained in the same position throughout the plastic operation and during the subsequent application of the plaster-of-Paris shoulder spica. This posture of the upper extremity was first described by the author in 1908,[1] and is considered most essential in securing the proper fixation of the arm

[1] Albee, F. H. Epiphyseal fracture of the upper end of the humerus: two cases successfully treated by a new method. Post-Graduate, 1908, June; Juxta-epiphyseal fracture of the upper end of the humerus, a new postural treatment. Med. Rec., 1912, May 4.

following all plastic work about the shoulder, as well as in cases of fracture of the surgical neck of the humerus.

The fields of operation, previously prepared by the usual iodine technique, were exposed. The upper portion of the left humerus was laid bare by a slightly curved incision, revealing the tumor which extended up to the articular surface of the humeral head and downward over the surgical neck of the humerus for a distance of about 3 inches. As soon as the tumor was sufficiently exposed, a specimen was resected and examination by frozen section was immediately made by the laboratory pathologist, who was present during the operation, at the author's request. The specimen was pronounced sarcoma; and at a subsequent laboratory examination, the tumor was found to be of the giant-cell variety.

Having confirmed the original diagnosis, the following radical operation was decided upon and performed: The soft parts were separated by blunt and sharp dissection, taking care to keep well outside the area of the new-growth. By means of a large aneurism needle, the Gigli saw was passed beneath the shaft of the humerus at a point about 4½ inches from the upper extremity of the bone, and well below the tumor (see *a*, Fig. 3). The shaft of the humerus was completely severed at this point. The lower end of the fragment which contained the tumor was then elevated by means of a small Lambotti clamp, while the complete separation of the humeral fragment from the overlying soft parts was accomplished by blunt and sharp dissection, as shown in *b*, of Figure 3. After removal of the fragment, the upper end of the humeral shaft was prepared for the reception of the fibula transplant which was to replace it. The marrow cavity of the humerus was slightly enlarged, and, by means of the twin saw, a groove was cut in the upper end of the shaft extending downward about one-half inch. The wound was then packed with a hot saline compress to prevent drying of the tissues, while the transplant was being removed from the fibula.

Over the outer aspect of the upper third of the left leg, an incision was then made posterior to the site of the fibula, for it has been found that the head of this bone may be approached from its posterior surface more easily and with less damage to the nerves supplying the anterior group of muscles of the lower leg. The upper end of the shaft of the fibula was then developed by blunt dissection and the external popliteal nerve was laid bare and retracted laterally by means of gauze tape, in order to prevent any injury to it.

Having exposed the anterior external surface of the head and about 5 inches of the upper portion of the shaft of the fibula, a Gigli saw was passed beneath the shaft by means of a large aneurism needle at a point far enough down on the shaft to allow the cutting of a transplant which should exceed the length of the humeral fragment just removed by about 1 inch (see *c*, of Fig. 3). The

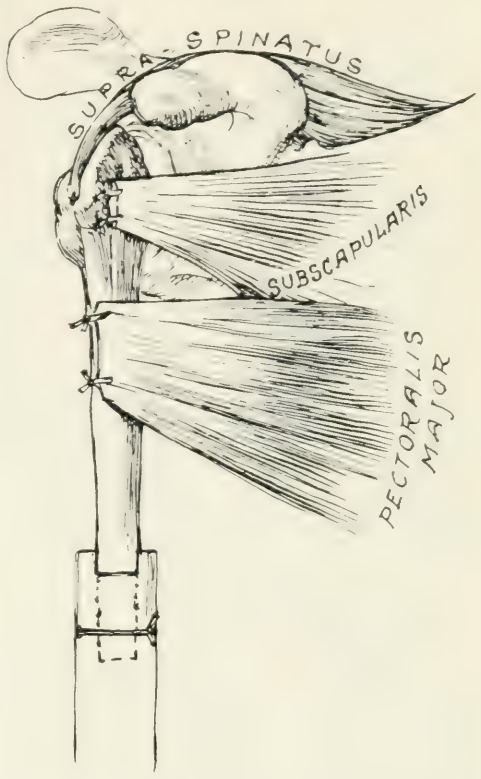

Fig. 4. Case 1. Each muscle was fastened upon the fibula transplant in the place of its proper insertion by means of kangaroo-tendon which was passed through drill-holes made in the bone.

shaft of the fibula was then completely severed by means of the Gigli saw, and the lower end of this fragment was elevated upward and outward by means of a lion-jaw clamp, while the head of the fibula was freed from the upper end of the tibia by severing the tibiofibular joint-capsule and the overlying peri-osseous structures (see *d*, of Fig. 3). After removal of this transplant consisting of the head and about 4 inches of the upper portion of the shaft of the fibula, the wound in the leg was treated in the author's usual custom, as follows: The skin was closed by continuous suture of No. 1 plain catgut, and the suture-holes were "puddled" with 3½ per cent tincture of iodine, the excess being immediately wiped away. A large dressing of gauze and sterile cotton was applied, with firm, even compression by bandaging with gauze.

The fibula fragment which had just been removed was then prepared for insertion into the shaft of the humerus. While an assistant held the Albee motor-saw upon the edge of the instrument table, the angular projections on the surface of the fibula shaft were roughly trimmed down for about 1 inch, and the diameter of the shaft was thus made

Fig. 5. Case 1. Roentgenogram taken 4 months after bone-graft operation. Note complete bony union of lower end of graft with the humeral shaft and the tendency to cortical fusion. The arrows indicate drill-holes in graft through which muscles were attached by means of fine kangaroo-tendon at proper place of insertion.

Fig. 6. Case 1. Roentgenogram taken 2 months after Figure 5. Complete bony union of graft and humeral fragment had taken place when the patient fractured the graft by a severe fall.

slightly smaller at the lower end of the fragment so that it might be easily inserted into the humeral shaft which had already been prepared to receive it. The fibula transplant was then driven into the marrow cavity of the upper end of the humeral fragment, by means of mallet-blows upon the lion-jaw clamp which firmly held it, until the "shoulder" (which had been formed by the termination of the saw-cuts made in trimming the fibula shaft) fitted snugly in the groove already made in the upper end of the humeral shaft. In other words, the fibula transplant was driven into the humeral fragment, until the head *just* engaged under the acromion process, while traction was exerted upon the arm in order to restore, as far as possible, the normal length of the upper arm (see *e*, Fig. 3).

Having inserted the head of the fibula in the place formerly occupied by the humeral head under the acromion process, that portion of the capsule which remained was now drawn about the shaft of the fibula, just below the head. The upper end of the humeral fragment, in which was inserted the fibula, was then drilled in such manner that the drill pierced both bones completely. A strand of medium-sized kangaroo tendon was passed through this drill-hole and tied securely to prevent any possible slipping of the graft (see *f*, of Fig. 3).

Muscle-insertions. The musculature in this case was quite unimpaired, with the exception of the distal end of the pectoralis major which had been resected for about ½ inch, in order to escape wide of the area of the tumor. It was thus possible to dissect out and separate the various muscles which were fastened, each in the place of its normal insertion, upon the head and neck of the fibula by means of small kangaroo-tendon ligatures which were passed through drill-holes (Figs. 4 and 5) made in the head and upper portion of the fibula

transplant. The insertion of the individual muscles is shown in Figure 4.

The fasciæ were then closed by continuous suture of chromic catgut No. 1, and the skin-closure was made by continuous suture of plain catgut No. 1. Following operation, the arm was immobilized in a plaster-of-Paris shoulder spica in the elevated posture shown in Figure 2, and left undisturbed for 12 weeks.

Roentgenographic examination at the time of removal of the spica revealed firm and solid union of the graft with the humerus. This is shown in Figure 5. The patient began to recover function rapidly in her left arm and shoulder. She was soon able to resume the care of her small children and to follow her regular household duties. A second roentgenogram, taken 4 months after operation, showed continued proliferation of the graft and increased density.

On the morning of December 24, 1919, 6 months after operation, the patient accidentally slipped and, reaching out for support, brought the weight of her body to bear heavily upon the left arm and shoulder, with the disastrous result that the graft was fractured at about the junction of the middle and lower thirds. Figure 6 is a roentgenogram which was taken on that day. An immobilization in plaster was immediately made by her physician, and 2 weeks later the plaster was removed and the arm and shoulder were again incorporated by the author in a plaster-of-Paris shoulder spica, with the arm maintained in an anterior elevated posture (Albee's position) upon the fracture-orthopedic table. On March 18, 1920, about 10 weeks later, the cast was removed and physical examination indicated solid union between the two graft fragments. This was confirmed by the roentgen-ray which, as shown in Figure 7, revealed a remarkable bone growth.

The patient has continued to regain use of the left arm, and roentgenographic examination made at time of writing (May 15) shows even greater proliferation of bone about the original site of fracture. It is yet too soon to estimate how complete has been the restoration of function in this case. Prior to the accidental fracture of the graft, the patient gave every promise of recovering the normal use of her arm and shoulder. It is but reasonable to assume that the ultimate restoration of function will be quite as satisfactory and complete as was indicated before the accident occurred.

This case has been of extreme interest also in reference to the question of recurrence of the sarcoma. Up to date there is no indication of recurrence.

William B. Coley, in recent correspondence, states that it is the only case he knows of in which a resection for sarcoma of the humerus was done and no recurrence appeared after 18 months. The following is a transcript of Ward J. McNeal's pathological report:

The specimen was taken on June 4 and report made June 7, 1919. Upper end of the left humerus

Fig. 7. Case 1. Roentgenogram taken 2 months after Figure 6, showing not only complete and firm union of the graft, accidentally fractured, but a remarkable proliferation of new bone, which forms a true plumber's "wiped joint" about the original site of fracture.

11 centimeters in length is divided by saw-cut just below the articular surface. A circular depression 15 millimeters wide and 5 millimeters deep is present in the head, opening on to the cut surface. This cavity extends into the larger fragment where membranous material presents. The tumor is only moderately firm and occupies especially the posterior aspect of the shaft. By sawing the shaft longitudinally the tumor is exposed. Its cut surface at the middle measures 70 by 32 millimeters. It involves the narrow cavity near the upper end and has eroded the entire posterior portion of the shaft for about 45 millimeters from the head. Lower down it appears to be quite outside the bone. In gross structure the tumor is a multilocular cyst. The cysts are filled with disintegrated blood.

Microscopic examination. Paraffin sections of the softer parts of the tumor show it to consist of spindle cells with a considerable amount of intercellular fibrillar substance. Numerous round cells, polynuclear leucocytes and considerable old blood pigment are found throughout. In places there are abundant multinucleated giant cells. Areas of recent hæmorrhage into the tumor substance are present in the sections.

Diagnosis. Giant cell sarcoma (myeloid sarcoma).

Result of examination, frozen section diagnosis. Spindle-cell Sarcoma.

In the second type of shoulder case classified in Group I (Sub-group B) the muscles are sufficiently preserved to allow the reconstruc-

Fig. 8. Case 2. In this case, the head and upper end of the right humerus were removed as a result of severe injuries received in an automobile accident. The photograph shows the sagging of the arm and the flail condition of the shoulder, due to the loss of bony framework.

tion of the shoulder-joint, but it is impossible to separate them individually. The bone loss in these cases is restored by the head and upper portion of the shaft of the fibula, as in the foregoing type (Case 1), and the technique followed is similar. In this second group,

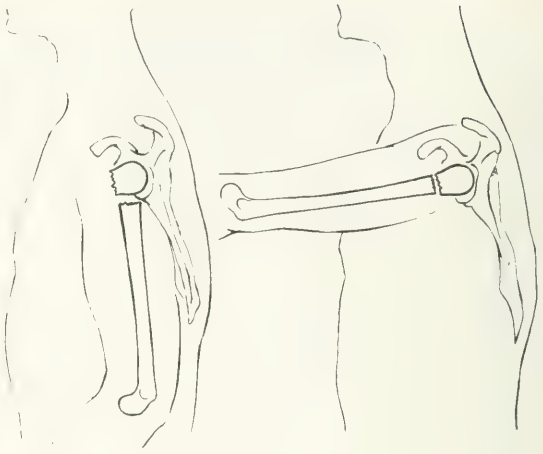

Fig. 10. Case 2. Diagrammatic drawings to illustrate the position of the humeral fragments: *a*, when the arm is put up in the old, classical posture parallel with the trunk; *b*, when the arm is maintained in the author's anterior, elevated position, at right angles to the trunk.

Fig. 9. Case 2. Roentgenogram taken at an oblique angle, showing comminution of the upper portion of the right humerus.

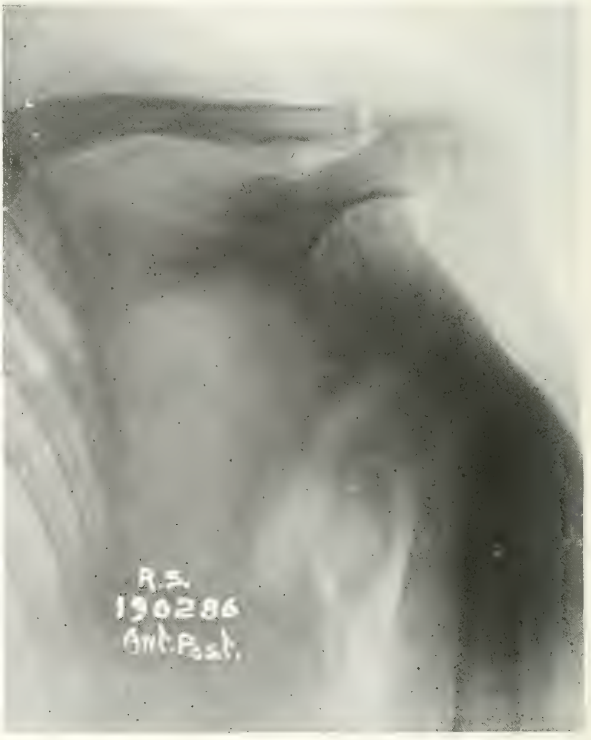

Fig. 11. Case 2. Roentgenogram showing loss of about 5½ inches of upper end of the bone.

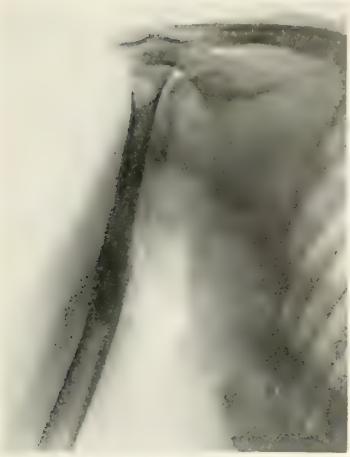

Fig. 12. Case 2. Roentgenogram, taken 6 months after plastic operation showing the bony framework of the upper arm restored by the head and upper end of fibula, with firm union of the graft and the humeral fragment.

however, it is necessary to attach the muscles *en masse*.

Two cases of the author's series are especially illustrative: in both, loss of bone in the humerus was due to severe trauma; in one instance, an automobile accident and in the other, a shell injury received in battle. The amount of bone missing in each case was great, and there was associated infection with some impairment of the musculature. Restoration of function in each case has been interesting and gratifying, inasmuch as it has permitted an accomplished artist to return to her profession of the piano in the first instance, while in the second case, a young American soldier, severely wounded in France, has sufficiently recovered the use of his left arm and shoulder to return to work in a machine-shop, where he has been employed since his discharge, a number of months ago. These two cases are briefly outlined, as follows:

Case 2. Miss T., a musician, age 38, was severely injured in an automobile accident, resulting in the comminution of the upper portion of the shaft of the right humerus. She was immediately taken to a hospital where, after an unsuccessful attempt to readjust the humeral fragments by manipulation, an open operation was performed a week after the accident. Two bone-splinters were removed, and the arm was put up in a plaster cast in the old classical position, parallel with the trunk.

Fig. 13 (at left). Case 2. The ability to raise the upper arm with the forearm is shown. This photograph and the following one were taken 8 months after reconstruction of the shoulder-joint.

Fig. 14. Case 2. The patient uses her right arm with great ease. An accomplished pianist before injury, she has recently been able to resume her professional work.

Fluoroscopic examination at the end of 6 weeks revealed non-union of the fragments, which were in the extremely faulty alignment shown in Figure 9. The head of the humerus was rotated upward and anteriorly, so that the fractured surface was directed anteriorly, instead of approximating the fractured end of the long humeral fragment which came in contact with the intact, spherical side of the head. The rotation of the humeral head, it should be remarked in passing, was due to the *unopposed* pull of the supraspinatus and subscapularis muscles, an important factor which, as shown diagrammatically in Figure 10, must always be reckoned with in fractures of the upper humerus, but which was apparently entirely overlooked in the postural treatment of this case. Under such conditions of faulty alignment, union of the humeral fragments was not only highly improbable, but, owing to the approximation of the end of the long fragment with the *slippery, rounded* side of the humeral head, maintenance of the fragments in this position was very difficult.

There followed numerous unsuccessful attempts to bring the humeral fragments into position. The arm was put up as before in the old, classical position, parallel with the trunk, and later held slightly elevated and outward. No effort was made, however, to counteract the muscle-pull of the subscapularis and supraspinatus by adequate postural treatment. Nonunion persisted; there was associated infection and necrosis of the bone which necessitated frequent curettements. The condition of the patient's shoulder grew steadily worse, and 5 months after the accident, it was deemed necessary to remove the entire head and about 4 inches of the upper portion of the shaft of the humerus. Following operation, the Carrel-Dakin treatment was instituted and symptoms of infection rapidly subsided.

Fig. 15. Case 3. An American soldier wounded in France by fragments of a high explosive shell which destroyed the greater portion of the upper third of the left humerus, including the head. Note the sagging at shoulder due to loss of substance. The patient was powerless to raise the arm, owing to its flail condition, and he maintained the position shown in the photograph by firmly grasping his belt, after the arm had been "propped up" by an assistant.

At the end of 3 months, the patient was able to leave the hospital, at which time the soft parts were practically healed. Motion of the arm at the shoulder was, however, impossible, owing to the destruction of the continuity of the scapulohumeral joint. The actual loss of skeletal support is strikingly demonstrated in Figure 11, a roentgenogram taken after operation, which shows nearly 6 inches of bone missing from the upper humerus. The arm dangled heavily from the shoulder and was entirely devoid of muscle control (Fig. 8). The patient's mental attitude at this time was one of profound despondency. For nearly 11 months, she had been incapacitated, and although her right arm was now completely healed and free from pain, it gave no promise of returning usefulness. Before her injury, she had been an accomplished pianist, and with loss of all shoulder-joint motion and function, she was confronted with the prospect of relinquishing a profession that meant so much to her.

It was at this point that the patient came under the observation of the author. The possibilities of the bone graft were explained, and the patient's hearty co-operation was at once enlisted in the plastic procedure which, by reconstructing the shoulder-joint, was to restore function and motion of her upper right arm and shoulder.

Preliminary to the plastic work, however, deep massage was recommended to determine the presence or absence of latent infection. This is a precaution which should always be taken in cases which have previously shown infection, even though, as in this instance, there had been complete healing of the wound for more than 2 months. When after a month's treatment by massage there was no evidence of recrudescence of infection, the bone-graft operation was undertaken.

Restoration of the humeral loss in this case was accomplished by means of a graft more than 6 inches long, consisting of the head and the upper portion of the shaft of the patient's right fibula. The technique employed was similar to that followed in Case 1. In this case, however, loss of bone in the humerus was much greater and a longer graft was thus required to bridge the gap and supply the continuity of the scapulohumeral joint. It was found in Case 2 (and likewise in Case 3, which follows) that the end of the humeral fragment had become eburnated. This eburnated plug of cortical bone was removed and the marrow cavity of the humerus opened up in preparation for the fibula graft. Before inserting the fibula transplant into the shaft of the humerus, the glenoid cavity was laid bare, and, after the graft was in place in the upper end of the humeral fragment with the head of the fibula engaging under the acromion process, whatever remained of the capsule was drawn about the neck of the fibula by interrupted sutures of chromic catgut.

Owing to the prolonged earlier infection, in this case, it was not possible at the plastic operation to dissect out and separate the individual muscles, but it was necessary to attach them *en masse* upon the head of the fibula.

The author's usual plaster technique was followed in this case, the arm being immobilized in a plaster-of-Paris shoulder spica in the same elevated, anterior posture in which it had been maintained during operation (Fig. 2). Convalescence was uninterrupted, and the cast was removed at the end of 12 weeks, when roentgenographic examination revealed firm and solid union of the graft with the humerus. Figure 12, a roentgenogram taken about 6 months after operation, shows continued proliferation and strengthening of the union.

In this case, as in all cases of *surgical reconstruction*, the postoperative treatment was an important factor in the end-results. As soon as possible, after removal of the cast, the patient was encouraged to use her right arm cautiously. Slowly, but progressively, she began to show gain in function, and in the early convalescence she was directed to work systematically at the piano, her former profession. This was done with the twofold object of (1) physical stimulation of the graft and muscles and increase of motion through active exercise, and (2) influence upon morale, by proving to the patient that that skill which she feared was lost *could* and *would* eventually be regained through her own efforts.

The patient made remarkable progress, both in respect to the physical growth of the graft, and in recovering her former ability as an artist. Eight months after the operation in which her right shoulder-joint was reconstructed, she was able to give a recital on the piano, so complete had been the restoration of shoulder motion and function. Figure 14 is a photograph taken at this time. By conscientious and intelligent re-training, she has succeeded in

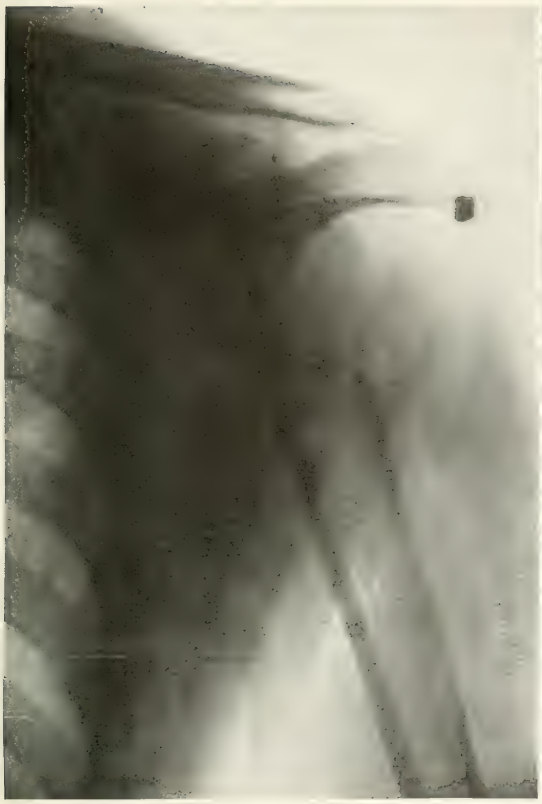

Fig. 16 (at left). Case 3. Roentgenogram showing the humeral shaft displaced internally.

Fig. 17. Case 3. In this case, preservation of the greater part of the musculature of the shoulder made it possible to restore shoulder-joint function by transplanting into the shaft of the humerus the head and upper end of the patient's left fibula. Roentgenogram taken about 2 months after operation, shows the transplant in place with good proliferation of new bone.

regaining her former technical skill and at time of writing (11 months after operation) has resumed her profession as pianist, and is again appearing in public recitals and concerts, as formerly.

Case 3. An American soldier, age 25, was wounded while on duty at Mt. Kemmel, in France, by fragments of a high explosive shell, which passed through the left shoulder, severely comminuting the head of the humerus, and resulting in the later operative removal of the head, neck, and a portion of the shaft of that bone (see Fig. 16).

Upon admission to U. S. Army General Hospital No. 3, at Colonia, Jew Jersey, his general physical condition was good, and his wounds had been healed for about 2 months. There was partial paralysis of the left arm, which, owing to its flail condition, was quite useless (Fig. 15).

Four months after complete healing of the wounds (the absence of any latent infection having been ascertained by rough manipulation and deep massage), the plastic operation for the restoration of loss of bone in the humerus was performed by the author. A transplant, consisting of the head and upper 3 inches of the shaft of the patient's left fibula, was used to replace the destroyed portion of the humerus. The technique employed was similar to that followed in Case 2. Having exposed the upper portion of the humeral fragment, the marrow cavity was opened up by removing the eburnated plug of cortical bone at the end of the fragment, and the fibula graft was driven into the medullary cavity, thus prepared, for about 1½ inches, a distance much deeper than in the two preceding cases, as shown in Figure 17. The bone-graft operation was performed 7 months after injury and 4 months after complete healing of wound.

On account of loss of the upper end of the humerus in this case by gunshot injury, and the suppurative process following, it was impossible to dissect out and develop the ends of the individual muscles, as had been done in Case 1. The head of the fibula was, therefore, placed in the glenoid cavity under the acromion process, in as nearly the normal position (of the humerus) as was possible.

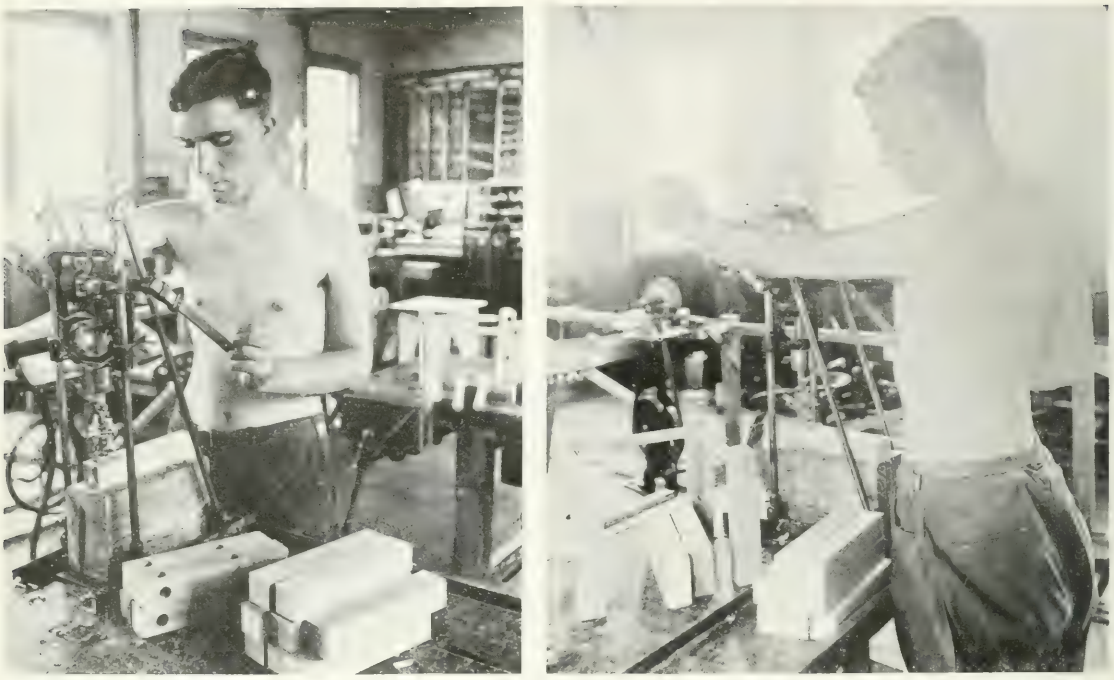

Fig. 18. Case 3. Patient is at work at a wood mortising-machine, 3 months after plastic operation. Shoulder-joint motion and function have already been restored to a notable degree, as is evidenced by the almost equal excursion of the two arms. This man was shown in the Rehabilitation Exhibition at the annual meeting of the American Medical Association, at Atlantic City, in June, 1919.

The soft tissues, in which were embedded the shoulder-muscles, were then opened up in the region formerly occupied by the lost portion of the humerus; through the subsequent union of these soft parts and embedded muscles with the outer surface of the fibula, a considerable amount of muscle-function resulted. This is demonstrated in Figure 18, taken about 3 months after operation, in which Case 3 is shown at work at a mortising-machine which demands the almost equal excursion of the two arms.

Case 3 illustrates the extreme value of vocational therapy in developing function in an impaired limb or joint. As soon as the plaster shoulder spica was removed in this case, he was put to work in the hospital "Curative Wood-Working Shop," under the direction of Lieutenant Lorenzo Denslow, S. C., U. S. A. Special machines best suited to meet the physical requirements of the individual patient were always selected in this department of vocational therapy. The wood-mortising machine seemed especially adapted to meet the needs of Case 3, who by working it systematically not only stimulated healthy bone growth in the newly reconstructed shoulder, but soon began to realize that his shoulder was not useless and that the more he tried to use it (with moderation) the more he was able to accomplish—a most healthy influence upon his morale.

As in all the cases herewith reported, the history of this man has been followed closely during the fourteen months which have elapsed since the plastic operation. He has continued to regain function in his reconstructed left shoulder, and has been able to return to the machine-shop, in which he has worked since his discharge, a number of months ago. The arm is strong and stable, and roentgenographic examination made at time of writing (May 15) reveals firm, solid union.

Group II includes cases of severe traumata, such as crushing accidents, or war injuries from shrapnel or shell-fragments, in which there may be not only great comminution of bone, or even its complete removal by passage of the projectile, but also destruction of the musculature to such an extent as to render impossible any hope of restoring the former shoulder-joint motion. These cases are the most difficult to repair, for here there is not only the problem of restoring the bone loss as far as possible, but of securing the proper posture of the arm to allow compensatory function from the action of the scapulo-

Fig. 19. Case 4. Roentgenogram showing loss of about 3½ inches of the upper portion of the shaft of the humerus, including the entire head. In this case, shoulder-joint motion was impossible, owing to the extensive destruction of the musculature of the shoulder.

Fig. 20. Case 4. During the plastic operation in this case, in which a truss-work of tibial grafts arthrodesed the humerus to the scapula, the arm was held in the posture shown in the photograph, and the same position was maintained in the application of the plaster-of-Paris shoulder spica, shown in Figure 23.

thoracic muscles. It has been the author's custom, in this type of case, to restore the lost head and upper portion of shaft of humerus by a truss-work of tibial grafts, stabilizing the upper arm and ankylosing the humerus to the scapula. Following transplantation of the bone, the arm has been immobilized in plaster in an elevated, anterior posture with the hand brought in front of the face, so that later the scapulothoracic motion may be compensatory for lost shoulder-joint motion.

Case 4, that of an officer in the recent war, is illustrative of this type of shoulder restoration. The history is given, as follows:

R. K., age 23, was struck by fragments of a high explosive shell, while on duty near Ourcq River in France. One fragment, entering the right shoulder, fractured the head of the humerus and embedded itself in the anterior chest-wall, below the clavicle. A second wound was made by a fragment which entered the back beneath the angle of right scapula, passed inward, and made its exit a little to the right of the spine, at the level of the sixth dorsal vertebra. Another shell-fragment passed from without inward through the lumbar muscle on the right side, at the level of the fourth lumbar vertebra. Two further wounds were made by fragments which entered the right arm, one just above, and one below the elbow. Numerous operations were performed in France for the removal of dead bone. The musculature became greatly impaired, due to extensive loss of tissue by destructive influence of the high explosive shell and associated infection. Much of the muscle had been replaced by extensive scar-tissue.

R. K. was admitted to U. S. Army General Hospital No. 3, at Colonia, New Jersey, 3 months after injury. He was a man of splendid physique and, with the exception of loss of function of his right shoulder-joint, his general condition at this time was excellent. His wounds were entirely healed, without any pain or tenderness. Roentgenographic examination of the right arm and shoulder, as shown in Figure 19, demonstrated absence of the entire head and upper third of the humerus. Func-

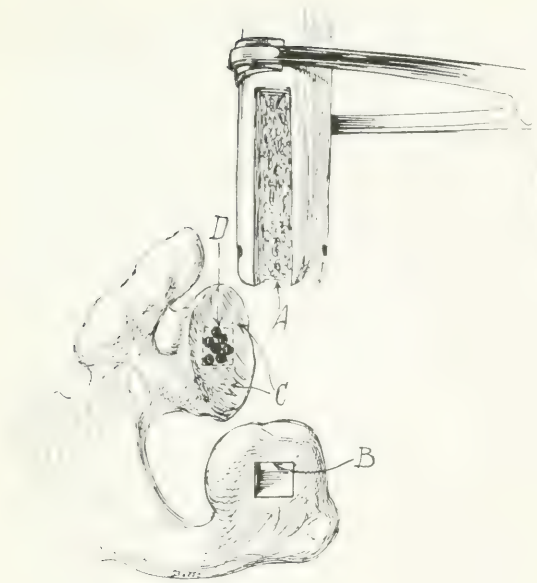

Fig. 21. Case 4. Diagrammatic drawing (superior view) showing groove *a*, in humeral fragment; mortise *b*, in acromion process; glenoid cavity denuded of cartilage, *c*; and holes drilled at *d*, preparatory to making the mortise in glenoid cavity. (Albee. *Orthopedic and Reconstruction Surgery.*)

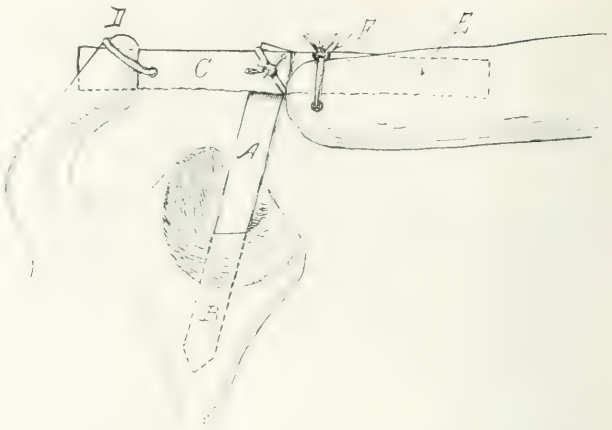

Fig. 22. Case 4. Diagrammatic drawing (anterior view) showing truss-work of tibial grafts in place and fixed with kangaroo-tendon ligatures. Graft *c* is inlaid into the groove prepared in the shaft of the humeral fragment, at *e*, and mortised into the acromion process at *d*. This graft is slightly dented by the motor drill at *f*, and kangaroo-tendon passed through a drill-hole at end of the humeral fragment is fastened at this point in order to hold the graft more securely and prevent possible slipping. A second kangaroo-tendon ligature is made at *d*, passing through a drill-hole in the graft and over the tip of the acromion process. Graft *a*, cut with one end wedge-shaped, is mortised into the glenoid body of the scapula at *b*, and attached by kangaroo-tendon to graft *c* at the point where the latter graft meets the end of the humeral fragment. (Albee. *Orthopedic and Reconstruction Surgery.*)

tion at the elbow, wrist, and hand were unimpaired, but, owing to the flail condition of the upper arm, the patient had no power of motion at the shoulder, and was quite unable to raise his hand to his head. Any attempt at voluntary motion merely caused the upper end of the humeral fragment to approximate the scapula.

Prior to the plastic work upon the shoulder, the patient was given daily treatments by deep massage for the purpose of ascertaining the absence of latent infection. Five months after injury and 2 months after complete healing of the wounds, the plastic operation for the reconstruction of the shoulder was undertaken.

The technique was as follows: With the patient in the dorsal position upon the author's fracture-orthopedic table, as shown in Figure 20, the right arm was first placed in an anterior, elevated posture, with the humerus rotated so that the hand came before the face. With the arm in this position in relation to the scapula, it was possible, after ankylosing the humerus to the scapula, to utilize the powerful scapulothoracic muscles in place of the shoulder musculature which had been destroyed. This position was maintained, with 10 or 15 pounds of traction, during the operation and also throughout the application of the plaster-of-Paris shoulder spica which followed. The importance of securing this posture of the upper extremity and of maintaining it through the operation should be emphasized. The author's fracture-orthopedic table[1] enabled this to be accomplished.

Having exposed the fields of operation, a longitudinal incision was made from tip of acromion process downward over the upper end of the humeral fragment. By sharp and blunt dissection, the end of the acromion process, the glenoid cavity, and the upper end of the humeral fragment were thoroughly developed. These were then made ready for the tibial grafts in the following manner: With the blades of the twin motor-saw set ½ inch apart, the saw was introduced into the humeral fragment at its upper end and two parallel saw-cuts were made along the humeral shaft for a distance of 1½ inches, and extending down into the marrow. A cross-cut made at the termination of the twin saw-cuts completed the formation of a rectangular portion which was removed to form a deep groove in the humeral shaft, as shown at *a* in the diagrammatic drawing, Figure 21. In the acromion process a mortise (designated *b*, in Fig. 21) was then made, with its sides of the same dimensions as the width of the humeral groove, just completed. The glenoid cavity (Fig. 21, *c*) was denuded of cartilage and drill-holes were made at *d*, preparatory to forming a mortise.

[1] Albee, F. H. A new fracture-orthopedic operating table. Surg., Gynec. & Obst., 1918, xxviii, 683-689.

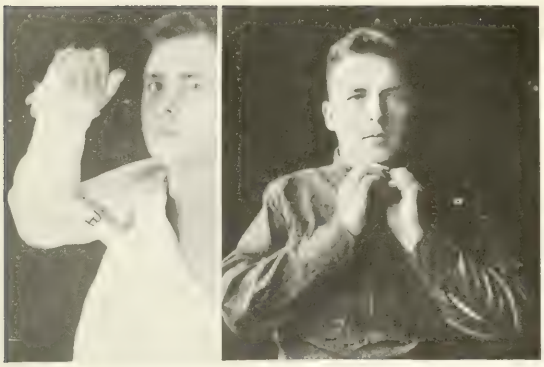

Fig. 23 (at left). Case 4. Following the plastic operation during which the right arm was held in an anterior elevated position with the hand brought in front of the face, the arm was immobilized in the same posture in a plaster-of-Paris shoulder spica, as shown in the photograph. This type of shoulder spica which the author always employs following arthrodesing operations for all shoulder-joint conditions, may be worn with comfort by the patient during the union and strengthening of the grafts, a period of from 10 to 12 weeks. By the truss-work strength of the supporting post, *b* (made by reduplication of ordinary plaster-of-Paris bandages), use of a large amount of plaster about the shoulder is obviated.

Fig. 24. Case 4. In this case the scapulohumeral joint has been arthrodesed by a truss-work of bone grafts, but, on account of posture at which union took place (shown in Figures 20 and 23) the ability to bring the hand to the hair and face, or neck-tie has been restored through the compensatory motion between the scapula and the thorax. Restoration of function by this means has been surprisingly gratifying owing to the action of the powerful muscles which control the scapula and, thus, the arm to which it is united.

Fig. 25. Case 4. This roentgenogram, taken 12 weeks after operation, shows restoration of upper portion of humerus by the two tibial grafts which have become firmly united with the host-bones. Graft 1 was inlaid into shaft of humerus and mortised into acromion process, while graft 2 was mortised into the glenoid body of scapula and attached to graft 1 at the point where the latter graft joined the end of the humeral fragment.

Tibial grafts. About two-thirds of the anterior internal surface of the right tibia was then laid bare by a skin incision over the crest of the bone. A long graft was mapped out by the scalpel in the periosteum of the central portion of the anterior internal surface. This graft was ½ inch in width and about 8 inches long which was of sufficient length to furnish two grafts for the proposed truss-work in the right shoulder. The requisite length of the two grafts had been first determined by means of flexible probes. The long graft was removed from the tibia by longitudinal cuts of a large single saw; a cross-cut was made to separate this graft into the two smaller grafts, one of which was cut with a wedge end. After removal of the grafts, the wound in the leg was closed in the usual manner by a continuous suture of the skin with No. 1 plain catgut, the suture-holes being "puddled" with 3½ per cent tincture of iodine and the excess immediately wiped away. A generous dressing of gauze and sterile cotton was applied with firm even compression.

Restoration of bone in the right shoulder was then accomplished by means of a truss-work of the tibial grafts just removed (Fig. 22). One graft (*c*, Fig. 22) was inlaid into the groove already prepared in the humeral shaft and mortised into the acromion process. This was reinforced by the second graft (*a*, Fig. 22), which had been cut with one end wedge-shaped, and was driven into the glenoid body of the scapula, and attached to the first graft at the point where it met the end of the humeral fragment. The grafts were then fixed securely with kangaroo-tendon ligatures. The fasciæ and subcutaneous parts were then closed by a continuous locking stitch of No. 1 chromic catgut. The skin closure was the same as that for the leg.

Following operation, the arm was immobilized in the same anterior elevated posture with the hand brought before the face (Fig. 23). A plaster-of-

Paris shoulder spica was applied from base of fingers extending up over the shoulder and thorax and down to the costal margins and the arm was left undisturbed for 12 weeks. At the end of that time, roentgenographic examination revealed a firm union of the grafts, with a considerable quantity of newly formed bone (Fig. 25). Owing to the position in which the arm was immobilized, it was soon possible for the patient, by the action of the powerful scapulo-thoracic muscles, to raise his right hand to hair, mouth, or neck-tie, functions of which he was incapable before operation.

Functional improvement in this case was rapid, and the patient showed an unusual eagerness to co-operate in all efforts to regain use of his limb. Five months after the operation, however, he unwisely attempted to lift a weight of over 150 pounds, and broke both grafts. Roentgenographic examination showed each graft fractured at the middle, although it had become well-united with the host-bone at the ends. A second operation was performed immediately, in which the graft fragments were put in apposition and two thin sliver grafts were placed along the points of fracture of each. Alignment was maintained by means of a plaster shoulder spica, which was worn for 10 weeks. Figure 24 is a photograph taken 4 months after the second operation, and shows the patient's ability to bring his right hand to his neck-tie. The percentage of return-function is however still questionable in this case, owing to the unfortunate fracturing of the grafts.

In no part of the anatomy, perhaps, are the benefits to be derived from bone restoration more strikingly manifest than in replacing loss of bone at the shoulder. Braces can accomplish very little in these cases of destruction of the head and upper end of the humerus, in which there is complete absence of skeletal support for several inches in the arm. In a corresponding loss of substance in the upper radius, for example, the splint-support of the ulna might be of considerable aid to the patient. In the bony anatomy of the upper arm no splint-support is provided for the humerus; when loss of substance in the humerus includes the head, no type of brace devised can be of much aid in restoring to any satisfactory degree the lost shoulder-joint function.

It has, however, been demonstrated that by means of bone-graft replacement of the lost portion of the humerus, restoration of shoulder-joint motion and function *can* be accomplished. In some cases loss of bone may be restored by a truss-work of tibial grafts. In many cases, the fibula, through its similarity in shape, has been used as the source of graft to restore the humerus, followed in no instance by untoward results nor by the slightest impairment of function of the leg. There is every reason to believe that loss of the upper portion of the humerus may be successfully restored, not only as to bone loss, but functionally as well. It is, however, a plastic procedure which entails a thorough understanding of the mechanics of the arm and shoulder and a technique based upon the physiological principles of tissue growth and healthy metabolism. The author feels that special stress should be laid on the careful observance of the following points in the treatment of cases of this type:

The pre-operative treatment. In every case of gunshot injury, or of previously infected wound, no plastic work of any kind should be considered until the wound has shown complete healing for at least 2 months. The absence of latent infection should be positively ascertained by daily treatments of deep massage and rough manipulation of the part for 1 to 2 weeks prior to operation. The temperature chart should be carefully studied and the part watched for any indication of sensitive areas or of exacerbation of a latent infection.

In those cases which previously showed persistent infection, the prevention of subsequent recrudescence may be still further assured by the removal of the *scar-tissue.* This is particularly necessary where there is extensive loss of soft parts with dense scar; in these instances, the healthy vascular soft tissues should be drawn in to replace the scar-tissue removed. If the removal of scar-tissue is extensive, plastic flap work may be necessary. The object of removing the scar is two-fold: (1) to avoid surrounding the graft with unfavorable, anæmic tissues; and (2) to obviate any possibility of infection, following the osteoplastic operation. When healing in these cases occurs by primary union, the plastic work may be done at the end of 2 weeks.

The immediate pre-operative preparation should be commenced 48 hours before operation. The first evening the treatment con-

sists of shaving of a generous area, with a thorough scrubbing with suds and gauze. The skin is well dried and followed 2 hours later by a scrubbing with benzine to remove fat. A thin coat of 3½ per cent tincture of iodine is then applied and the parts are covered with a sterile dressing. On the evening before operation, the dressings are removed and a second thin coat of iodine is applied and the limb again covered with a sterile dressing. On the morning of the operation the parts are again painted with a 3½ per cent tincture of iodine.

Posture of the arm. In the treatment of fractures of the upper humerus, with or without loss of bone, the position of the extremity is a most important feature. The usual course of events following such cases of fracture is strikingly illustrated in Case 2 (Fig. 9); owing to the unopposed action of the supraspinatus and subscapularis muscles, the humeral head is pulled out of alignment with the axis of the long fragment, and is rotated upward and outward, so that its fractured surface is directed anteriorly, instead of approximating the fractured end of the long fragment. As a result of this rotation of the head, the fractured end of the long fragment is directed against the side of the humeral head; if this be intracapsular, the fractured surface is contacted with hyaline cartilage; if extracapsular, the fragment end comes in contact with the slippery surface of the capsule.

The old, classical postural treatment of fractures of the upper humerus did not remedy these conditions so unfavorable to union. The arm was held parallel with the trunk, and the relative position of the fragments was practically unchanged, as shown in *a*, Figure 10. There was no approximation of the fractured surfaces, so essential to union; moreover, it was extremely difficult to hold the humeral fragments in this position, when the end of the long fragment was directed against the *slippery*, spherical side of the head. The repeated failures in fractures of the upper humerus to secure union of the fragments may be traced to inadequacy of this treatment.

Such unfavorable conditions may be wholly obviated by the author's method of treatment of fractures of the upper humerus, first described in 1908. By elevating the arm anteriorly, at right angles to the trunk, the long humeral fragment, which may be easily controlled, is brought into alignment with the head of the humerus, and fractured end is made to approximate fractured end, as shown in *b*, Figure 10. Most essential in this treatment is an apparatus which will permit a control of the upper extremity, so that the requisite posture may be secured and maintained not only during operation, but through the postoperative splinting as well. Indeed, the success of the operation depends very largely upon this feature of the work. This is particularly emphasized in cases such as the foregoing in which extensive bone loss in the shoulder presents great difficulties of support and fixation of the fragments.

The author's *fracture-orthopedic table* was devised largely for the purpose of allowing the surgeon a free control of the upper extremity and so far as the author is aware, he has developed the only apparatus which permits the requisite posture of the arm in the treatment of fractures of the upper humerus. By means of the table, shown in Figures 2 and 20, the arm may be suspended anteriorly at right angles to the long axis of the trunk, with as much traction applied as necessary, the body acting as the counter-traction. During operation, the patient is held in the dorsal position upon this table; the exact posture of the arm varying in the two types of operation, according to whether shoulder function is restored by the head and upper portion of the fibula (as shown in Fig. 2), or through arthrodesis by means of a truss-work of bone grafts (Fig. 20).

Immobilization. Upon completion of the operation, that portion of the table-top near the shoulder and upper part of the trunk is depressed to the required degree by turning the wheel (designated *a*, Figs. 2 and 20). By this means, the patient is suspended upon a thin body-rest which is situated under the occiput between the scapulæ and the spine. With the patient in this position upon the fracture-orthopedic table (Fig. 20) plaster cotton is applied from base of fingers, up over arm and shoulder, across thorax to the costal

margins. Over the cotton is applied a plaster-of-Paris shoulder spica, which is allowed to harden. A plaster-post (designated *b*, Fig. 23) is inserted between the forearm and chest portions of the splint, to obviate the need for a large amount of plaster over the shoulder.

The table arm-support for the upper extremity is then completely removed. The patient is lifted by manual pressure upon his back above and below the spica, so that the thin metal rest, which supported him during the application of the spica, may be easily drawn out from between the plaster and the body. The plaster is in no way loosened by the removal of this thin metal rest, which is $\frac{3}{16}$ inch thick and about 5 inches wide. Extreme care must be taken, however, that the shoulder spica itself is not lifted upon, since this would cause a "pinching-up" of the spinal rest between the plaster and the body, thereby interfering with its removal.

The plaster spica, thus applied, should always remain undisturbed for a period from 10 to 12 weeks. Following its removal, examination by roentgen-ray will determine how firmly the graft has united. Should any doubt exist concerning the strength of the graft or its union, a second spica, or a properly adjusted aeroplane splint, may be applied and allowed to remain on as long as is shown to be necessary by periodic roentgenographic examination. *Great conservatism* should be used in the final removal of all support in these cases, in which so much right-angle stress is brought to bear upon the graft.

Value of vocational therapy in surgical reconstruction. The author is convinced, from military experience and from civil practice, that *active motion* is much more potent in restoring function in these cases of surgical reconstruction than any form of passive exercise. In the majority of cases, this may be best accomplished in a curative workshop, similar to those which were established in our reconstruction hospitals, where special apparatus or some type of manual work particularly adapted to meet the individual physical requirements may be selected. This may consist in the use of a carpenter's mortising machine, as was demonstrated by Case 3 in Figure 18, or it may be in the use of the piano, as shown in Figure 14. The latter instance is a most remarkable illustration of the possibilities of functional re-education, under the supervision of the surgeon. In this case, an accomplished pianist, who for months had been incapacitated, was encouraged while still in the early convalescence to resume practice of the piano which meant so much to her. By systematic active exercise, carefully supervised, she not only convinced herself that her skill as an artist was not lost, but the voluntary use of the arm and the reconstructed shoulder-joint did much to stimulate the further proliferation and strengthening of the graft and its union. Eleven months after the operation, she was able to resume her recitals in public.

In the postoperative treatment of cases of bone-graft restoration, particularly in the type of case considered in this paper, active exercise through some form of vocational therapy is a most necessary adjunct. It is through function and the bearing of stress that bone growth is stimulated and the union of the parts is strengthened. It should, however, be emphasized that in these cases the vocational retraining should be under close supervision of a trained director, in conjunction with the surgeon, in order to avoid any possible injury to the grafted part at the same time that it is being developed to the maximum. The cooperation of the patient is a valuable asset, but extreme caution must be exercised in the early months of convalescence, lest the patient, over-ambitious, attempts some physical labor that is beyond the strength of the graft. In a similar instance (Case 4, of the foregoing series) the grafts, though well united and giving promise of excellent functional results in the fourth month after operation, were fractured a month later, because the patient attempted to lift a weight of over 150 pounds.

The value of vocational therapy has been strikingly illustrated in Case 3 (see Fig. 18). In this case of serious physical disability, with marked limitation of motion, the joint-adhesions, contracted fasciæ and lesions in tendons and muscles were worked out and the graft and muscles strengthened by working,

under supervision, in the hospital carpenter-shop. At the same time, the patient, who was at first despondent and rather indifferent, became interested not only in his work, but in seeing just how much he could do with his reconstructed shoulder. As a result, he grew convinced that his arm was once more useful and that he could do the work allotted to him. This feature of the treatment is particularly important in the postoperative care of industrial cases, included under the compensation laws. By the application of many of those forms of treatment which proved so successful in our military reconstruction hospitals, the return to usefulness of hundreds of our industrially injured may be hastened.[1]

[1] Albee, F. H. The application of rehabilitation methods from war to civil life. J. Med. Soc. New Jersey, 1920, Mar.

In the work of surgical reconstruction, expert care throughout the postoperative period is quite as essential to success as the technical skill required in the plastic procedure. The supervision of the surgeon should extend beyond the weeks of early convalescence. Throughout the trying months of functional re-training, the case must be watched and forms of physiotherapy and vocational exercise should be carefully selected to meet the physical needs. Many a case, which gives a brilliant prognosis, may result in failure, if the postoperative period is not closely supervised. This is a wide departure from the old order of general surgery in which it was believed that the responsibility of the surgeon ceased with the healing of the skin wound.

THE OPERATIVE TREATMENT OF INFANTILE PARALYSIS[1]

By ROBERT W. LOVETT, M.D., F.A.C.S., Boston

MY purpose is to present in this paper certain fundamental considerations bearing on the operative treatment of the disabilities resulting from infantile paralysis. Nowhere in surgery is there a subject which is more purely the application of the principles of general surgery to definite anatomical problems, nowhere can one find a more confused and befogged literature, and nowhere is there greater need of the application of sound common sense, straight thinking, and good general surgical judgment and technique, than in the class of cases under consideration.

Let us start with a clear definition of our field. Poliomyelitis is an acute infectious disease, accompanied in many cases by paralysis. The paralysis is incidental and not essential. When it occurs, it is a weakening or total loss of power in certain muscles, with no gross disturbance of sensation. Its distribution is widely scattered, very erratic, and not necessarily symmetrical. The lower extremities are very much more frequently affected than the upper. The paralysis is flaccid in type and reflexes are lowered. The only exception to this is in those very rare cases of poliomyelitis affecting the upper neuron resulting in spastic hemiplegia. These are not discussed here.

I am a firm believer in the need of rest in the early stages, and so long as weakened muscles are improving under treatment by muscle training. The more patients one sees the more one is impressed by the evil effects of fatigue in recent and in old cases. I have had no more satisfactory patient than a woman, whose acute attack was 34 years previous to her coming under treatment, yet 34 years of persistent overuse had not depreciated her muscles beyond the possibility of great gain in power under restriction of walking and non-weight bearing exercises. This factor is mentioned because it has a definite bearing on the after-treatment of operative cases.

With regard to our method of approaching these cases, I may perhaps be permitted one personal reminiscence. Some years ago, at one of our national medical society meetings, a business discussion, seemingly endless, had been going on for a long time, proceeding in circles and zig zags, returning to the starting point, repeating, misunderstanding, and so on, when one of the members rose and said that all human endeavor could be simplified by answering three questions: What are you trying to do? Is it worth doing? Are you doing it? He suggested its application to the discussion going on, which under these drastic questions quickly ended. In approaching operative questions in cases of infantile paralysis these questions may well be asked by himself by the surgeon, and answered by him before operating.

PARALYSIS OF THE LOWER EXTREMITIES

The discussion will be confined largely to paralysis of the lower extremities, as this is by far the most frequent location of the disease. Patients with infantile paralysis who come to the surgeon can be divided into two clearly defined classes: those who cannot walk, and those who can. Those who cannot walk wish if possible to be made to do so, and those who walk wish to be made to walk better. That is the whole story of the operative treatment of infantile paralysis of the lower extremities, to the further consideration of which we may now proceed.

The man who sees a large number of cases of infantile paralysis, over a sufficient period of time, comes to take a new and rather peculiar view of the requirements for human activity. His scale is changed and his attention is directed to certain fundamentals which do not enter into ordinary life. In this new scale he comes to recognize three essentials: (1) that the patient should be able to stand on his feet and progress in some manner or other; (2) that he should be able to get up and down out of a chair; and (3) that he should be able to go up and down stairs. The patient who is unable to stand must spend his life in a wheel

[1]Mayo Foundation lecture presented before the University of Minnesota Graduate School of Medicine and the Staff of the Mayo Clinic, Rochester, Minnesota, May 3, 1920.

chair or on a couch; the patient who can walk, but not get up and down, will require the constant presence of an attendant; and the patient who cannot go up and down stairs must have the services of an attendant for part of the time.

As has been stated, the problem consists in enabling the patient to walk with as much facility and as little lameness as possible, and to this end should be directed the operative and mechanical treatment. This approach to the question is chosen because, in my experience, many useless operations are being done, which are not enabling the patient to walk better, because it is not recognized in the examination of the patient that the problem is not only one of deformities or loss of power, but of securing increased activity and improved progression.

First as to patients who cannot walk. It may be formulated in advance that any patient of average intelligence with flaccid paralysis of the lower extremities, abdomen, and back can be made to walk in some form or other, provided he has one good arm, and one arm good enough to hold a crutch. This applies not only to poliomyelitis, but to fracture of the spine with total flaccid paralysis.

Practically all of these patients can be taught to get up and down out of a chair, and most of them can learn to go up and down stairs in some fashion or other. If deformities are present which prevent the assumption of the upright position, they must be removed, and the only cases that one need dismiss as hopeless are cases with flaccid paralysis of both arms, combined with flaccid paralysis, with or without deformities, of both legs. In my entire experience I have never seen more than three or four of these resulting from infantile paralysis, who could not be made to walk in some fashion or other.

The most common obstacle to getting a patient on his feet is flexion contraction of the hips, often combined with flexion deformity of the knees, and equinus of both feet. Either one of these deformities if bilateral is sufficient to prevent going about in the upright position. They are all easily dealt with.

Flexion contraction of the hips is readily removed up to the age of 25 by Soutter's operation—fasciotomy with detachment of the muscles surrounding the anterior superior spine of the ilium. In cases older than this I do not happen to have had experience with the operation, but it seems probable that in adults approaching middle life the contraction of the tissues might be so great that the operation would be unsatisfactory and perhaps dangerous.

The operation consists in a longitudinal incision 3 or 4 inches long, an inch or so outside of the anterior superior spine, which comes about opposite the middle of the incision. The fascia lata is exposed, cleaned of fat, and divided from the trochanter major nearly to the anterior superior spine. The spine is then loosened by an osteotome and the attachments of the soft parts are stripped subperiosteally from the crest of the ilium outside and inside for at least 1½ inches back. The soft parts are then detached from the anterior surface of the ilium down to the anterior inferior spine. The thigh is then extended, the soft parts give way, and it has never in my experience been necessary to divide the psoas muscle to secure full correction. After extension of the thigh, the denuded part of the anterior surface of the ilium sticks out under the skin, and it is my personal practice to cut this off with a pair of bone forceps. The wounds are stitched up and the patient may either be put up in a plaster spica bandage, holding the leg in mild hyperextension, which is changed to a position of marked hyperextension at the end of 10 days, or the patient is put to bed on a frame without plaster for 10 days or so, after which hyperextension plaster is applied. The position of hyperextension, which must be free from any element of abduction of the leg, should be maintained for about 6 weeks, after which it is desirable for the patient to lie for 2 or 3 hours a day in a position of hyperextension and slight abduction, although ambulatory activity can be allowed at the end of 6 weeks, in braces if necessary, which is generally the case. A free loosening of all resistent tissues is necessary, particularly of the periosteum of the ilium, and no ill effects have been noticed from detaching the attachment of Poupart's ligament. There is very little bleeding, and

the cause of the serious effects occasionally following the operation in children are not clear.

In a large number of patients operated on, of ages from 3 to 25, I have had three relapses, two of these occurring in young children, where the operation is more difficult on account of the softness of the tissues, and the incomplete ossification, and in the third case it was, I believe, the result of imperfect after-care, the girl coming from ignorant parents, who did not insist on her going about after operation, but allowed her to sit uninterruptedly for 2 years. In one of these cases a second operation was satisfactory, although difficult on account of the ossification of the transplanted periosteum.

I have been fortunate in having no deaths in my personal cases, and I know of only one death that occurred on the orthopedic service of the Children's Hospital, where a still larger number of operations have been performed, and this death was apparently due to shock.

The operation, however, is not free from risks, and complications are not infrequent. In one case in which I put the leg immediately in a position of extreme hyperextension, the foot and the leg one-half way up to the knee immediately became cold and circulation was not restored for 2 days, although the leg was flexed a few hours after operation. In this case, apparently the lumen of the femoral artery had been diminished by stretching the artery and a thrombus had formed. I have never since put a leg in much hyperextension at the time of operation. I have had one case of suppression of urine, which threatened to be serious, but from which the child recovered. I have seen several cases of convulsions occurring soon after operation. Acidosis in children occurs after many of the severe operations of all sorts, and following this operation I have seen a good many severe cases of it. Tenderness of the knee is occasionally marked on taking the leg out of plaster, but soon wears off.

In the case of very young children, I believe that it is not advisable to perform the operation, especially as many of them can be stretched out by plaster spicas. The operation should I believe be done as early as the contraction has reached a serious grade, and it is to be remembered that it is due primarily to the persistence of the hip flexors, and the paralysis of the hip extensors. The balance of these should be studied before operating, because in certain cases in which both sets of muscles are equally affected, an adaptive shortening comes on from prolonged sitting, which will often disappear under treatment by stretching. I learned my lesson in this respect from a boy who came to one of the Long Island clinics, who had gone on all fours for some years. He came to Boston for operation, and as it was impossible to operate on him for a couple of weeks for certain reasons, he was put to bed and traction put on his legs. At the end of 2 weeks there had been such a marked diminution in the contraction that I put him up in plaster, which resulted in his legs coming straight without operation. In this case there was an equal involvement of both extensors and flexors, and it is well to bear in mind that the serious form of the deformity does not occur in cases in which hip flexion power is not predominant over hip extensor power.

The old operation of transverse anterior division of contracted structure is most unsatisfactory and very often followed by complete relapse of the deformity, however extensively performed.

Paralytic dislocation of the hip-joint. This troublesome deformity in my experience is practically always associated with, and the result of, hip flexion contraction. The dislocation is nearly always posterior, and the former method of relieving it has been to perform an arthrodesis of the hip, which is often unsatisfactory in childhood, as the parts forming the joint are so largely cartilaginous at that period that failure to fix the joint has often resulted, in addition to which a stiff hip is always a handicap. With a contraction preventing full extension of the thigh and a paralyzed gluteus maximus behind the joint, the contraction acts as a bowstring in attempted full extension to throw the head of the femur out over the posterior shallow rim of the acetabulum.

A procedure which I have applied in these cases has been to relieve the contraction by

fasciotomy, making also an incision over the posterior part of the capsule of the hip-joint, which is plaited; and then to put the leg up in a position of abduction and overextension for a period of 6 months. A limited number of these cases have shown a permanent reduction of the dislocation.

The second of the deformities which is likely to prevent walking, especially if present in both legs, is *permanent flexion of the knee*, due in most instances to the persistence of the hamstrings and the weakening of the quadriceps muscle. The adoption of a very simple technique for correcting this deformity has resulted in practical abandonment of operative measures for the relief of the deformity, although such might easily be necessary in very severe cases. Since its adoption some 5 or 6 years ago, I have not found it necessary to operate on any case of knee flexion deformity, due to poliomyelitis, all cases coming under my care, including severe ones of long duration in young adults, having yielded to the method of gradual stretching. The objection to sudden reduction of a severe knee flexion under anæsthesia is that subluxation is apt to persist and to appear as an unsightly deformity after the leg is straight. This has been noticed several times in reduction under ether without the division of the hamstring tendons.

The gradual reduction alluded to is accomplished by putting a circular plaster on the leg from the toes to the groin in the position of deformity, allowing it to harden for 24 hours, and then making a transverse slit through the posterior two-thirds of the plaster at the level of the popliteal space. Thin pieces of wood are then put in the slit to force it open, and the conditions of leverage are so favorable that the knee straightens rapidly.

Equinus deformity of the foot is the third deformity, which if existing in both legs, makes walking practically impossible. The division of the tendo Achillis has been the customary method of removing this deformity, and has been considered a trifling affair, but from the point of view of ultimate function it is an operation, in my opinion, to be done with caution. There are two definite reasons for this:

1. If the anterior muscles of the ankle are paralyzed, a flail foot results. After tenotomy a foot of this description in the position of equinus is often a useful weight-bearing member, but once converted to a flail foot it may become insecure and troublesome. My feeling, therefore, is that tenotomy of the tendo achillis should not be done in cases where the anterior muscles are paralyzed, unless at the same time some means are adopted to prevent a perfectly flail foot by tenodesis or the insertion of an anterior artificial ligament.

2. Another objection to the indiscriminate division of the tendo achillis to correct equinus is that if the quadriceps on that side is paralyzed or weak, and the hamstrings are good enough to prevent hyperextension of the knee, the existence of some equinus is a valuable asset and enables the patient to walk without a brace, whereas, if the equinus is removed and the normal amount of dorsal flexion is allowed, a brace generally becomes necessary for walking. A foot with a moderate equinus deformity when placed on the ground in weight bearing, locks the knee in extension, and the patient walks perfectly well without a brace, the only disability being that in a crowd if anyone hits the knee from behind the patient is likely to fall.

As a matter of fact, the division of the tendo achillis is generally not necessary in poliomyelitis to correct equinus, because most cases yield to a method of gradual stretching similar to that which is described for flexion of the knee. A plaster is applied from the toes to just below the knee, with the foot in the position of deformity, and an elliptical piece of the plaster is then removed from the anterior three-quarters of the bandage just over the fold of the ankle. A strap is put around the front of the foot and around the top of the plaster, and these two straps are connected by another webbing strap and buckle, and in most cases in from 10 days to 4 weeks the foot can be brought to or beyond a right angle.

Tripod walking. After the deformities described are corrected, there arises the question of getting these helpless people on their feet and of teaching them to walk. A peculiar method must be pursued, which may be spoken of as tripod walking. If the crutches

are placed apart and slanted well forward at their lower ends they form the two anterior legs of a tripod, while the third and posterior leg is formed by the body of the patient inclined forward at its upper part, with the feet well behind. Such a position is stable because the base of support is a large triangle bounded by the three points of support of the tripod, and because the body is stable in the over-extended position, for the reason that hyper-extension of the hips is checked by the Y ligament of Bigelow, and, with the knees stiffened by the braces, the center of gravity falls in front of the hip-joints and keeps them extended and firm. A paralyzed patient with no power below the waist can stand unsupported easily in this position provided there are no contraction deformities in hip, knee, or ankle.

The patient must next be taught to recover his equilibrium, if he has been long confined to his bed or chair. This must be dealt with by itself and restored by repeated practice in standing on crutches with support near at hand, or by standing with both hands resting on the foot rail of the bed. When he has sufficiently acquired self-confidence, he should begin on progression. This is accomplished by hitching one crutch a few inches forward, then the other crutch, and then, in cases of complete flaccid paralysis, jerking the feet forward together a few inches by a body movement, bearing down with the hands on the crutch bars and sliding the feet over the floor. If any degree of power remains in the flexor muscles of the hip, the feet can be more easily advanced one at a time, only the very worst cases having to slide along both feet together, the advancing of one foot at a time often being accomplished by a twisting of the body without any power in the hip flexors.

The one essential in bad cases is that the tripod should have a large base, and the body be sufficiently inclined forward to keep the center of gravity in front of the hips. If it falls behind them, the patient will double up backward like a jack-knife on account of flexion of the hips.

Having thus considered the question of making people able to walk, who never were able to walk before, we come now to the second consideration of improving the walk in those people who are able to get about, with or without apparatus, and this is the most interesting, and I think the most important problem in the treatment of infantile paralysis.

Regarding it, as I outlined it in the beginning, as a problem in walking, the question is: How can the patient be made to walk with the least fatigue and with the smallest amount of lameness? To do this it is necessary that a careful analysis be made of the gait, because an examination of the legs in the sitting position, essential as it is, fails to give the exact problem, because it does not take cognizance of the different combinations that exist on the two sides, which constitute the limp.

Every patient should be stripped and made to walk before the surgeon, and it is essential that the hips should be under observation. Adults are provided with a T bandage, and if the patient has apparatus, which is necessary for his walking, the apparatus should be applied with only boots and stockings on. In this way alone can the whole situation be made clear.

The point of view here advocated, of carefully analyzing the situation as a whole, is a little different from the ordinary one, which is too often concerned with the restoring of the muscle balance in the feet, and giving stability to the ankle. As I see it, a much more serious problem in the matter of lameness exists in the muscles of the abdomen and hips. A woman who takes pride in her appearance can be taught to walk in a good splint with a scarcely perceptible limp with no quadriceps or hamstring muscle, and nothing below the knee, provided the hip and abdomen are intact, but no woman, however much pride she takes in her appearance, or however much she may be coached in walking, can conceal or cover up a limp due to the paralysis of the weakness of the gluteus medius or gluteus maximus muscles.

From my point of view, therefore, in dealing with lameness these two muscles take precedence of all others and demand special consideration.

The function of the *gluteus medius* muscle is to abduct the thigh on the body, and when the

leg is on the ground to raise the other side of the pelvis by its use in walking. If it is paralyzed the patient compensates for this by leaning the trunk over on the affected leg, balancing in this way, and thus enabling the other side of the pelvis to be raised from the ground. The limp connected with the paralysis of this muscle is a sudden lurch to the side when weight is borne on the affected leg, and is indistinguishable from the limp caused by shortening. Attempts to conceal this limp by the use of apparatus have proved wholly unsuccessful. I had an interesting experience with a young girl, with a bad gluteus medius limp, who was willing to put up with any discomfort provided the limp could be concealed. A plaster jacket was put on to control the body, from the side of the plaster jacket then a heavy bracketted upright was run down to the knee, with a hinge opposite the hip-joint, and the leg was controlled by a stiffened leather splint reaching to the knee and attached to the iron. I did not see under these circumstances how it was possible for the patient to go on throwing the body to the side, which she did in walking. The apparatus was a complete failure, and had practically no effect upon the limp. Similar experiences have convinced me that no apparatus now in use is of any value in concealing the limp, although it can be minimized by the use of a corset and leg brace, which are connected by a heavy elastic strap running down over the trochanter, acting in the same line as the pull of the gluteus medius.

To sum this matter up, a paralysis or weakness of the abductor muscles of the leg causes a very conspicuous and unsightly limp, which is not concealed or remedied by any apparatus now in use, but which is minimized by the use of a strong elastic band.

With regard to the operative measure to remedy this paralysis: In a few cases I have performed a substitution operation of the vastus externus for the gluteus medius. A heavy tongue of the vastus externus, pointing upward, is detached on the outside of the thigh nearly up to the level of the trochanter major, and into this tongue one-half dozen heavy strands of silk are inserted, which are sewed in radiating lines into the periosteum of the crest of the ilium, and the leg is put up in a position of marked abduction and kept there for 6 months. After three months the plaster is removed for abduction exercises. Although a marked improvement in abductor function has resulted following operations I have performed, in no case has the operation done away with the limp, although it has been materially improved, and the parents of the children have been pleased with the operation.

The second muscle, which seems to me to be of the greatest importance, is the *gluteus maximus*. The gluteus maximus extends the thigh on the body, and when the leg is the fixed point, holds the trunk erect on the legs. In paralysis or weakness of this muscle when weight is borne on the affected leg the trunk is thrown back and the hip hyperextended, while weight is borne on that leg. The limp is exactly what one sees in the walk of a patient wearing an artificial limb for an amputation above the knee. The lameness is caused by the inability of the patient to hold the trunk extended on the affected leg in walking, and this posture is assumed to establish balance and compensate for the loss of the extensor muscles of the thigh, which, with the leg as a fixed point, operate to extend the trunk on the leg. The limp is most unsightly, and cannot be done away with by apparatus. No muscle seems available in this region for tendon transplantation, and it must be remembered, as will be mentioned in discussing tendon transplantation later, that the gluteus maximus is a very powerful muscle and could not be substituted by any muscle of ordinary strength. The use of a heavy elastic posterior strap has been most successful in diminishing this limp and is applied from a belt or corset to a leg brace. It must be attached to the brace below the knee or the patient is unable to sit down, because unless the knee is bent the elastic strap draws across the buttock with most uncomfortable pressure.

These two forms of lameness, from the point of view which I hold, are primary in their importance and are too often neglected while attention is diverted to more serious defects lower down, which are really secondary in importance. In recent cases I insist on rest or the use of crutches in order that these

muscles where they are affected shall not be overtaxed by walking, and I concentrate on the muscular development of these two muscles by muscle training. One trouble with muscle training is that inexperienced persons try to do too much, and spend a good deal of time and energy on the development of muscles which are of secondary importance in the walk, such as the quadriceps and hamstrings, paralysis of which can be so easily compensated for by proper fitting apparatus.

Two more limps connected with the hip and abdomen must be mentioned, although they are of less importance than the two discussed. In paralysis of the *hip flexor muscles*, which are the psoas and the tensor fascia femoris, a curious gait results. The patient swings the affected side of the pelvis forward by a rotary motion in order to swing the leg forward, as it is impossible to throw it forward in walking by the action of the hip flexors. If the disability exists on both sides in these muscles, the patient advances by a twisting motion of the pelvis first on one side and then on the other, the leg being flung forward by the twisting of the pelvis, and as abdominal paralysis or weakness too often exists with this combination the abdomen is likely to be prominent and the patient leans back from the hips. The gait is most unsightly, but fortunately not very common. No muscular transplantation seems likely to be of use or anatomically possible, but much can be done by the use of an abdominal corset and elastic traction running down the front of the thigh.

Abdominal paralysis is much more common than has generally been supposed. In the New York State (5) cases examined in 1916, recent cases showed abdominal weakness or paralysis in over 70 per cent of the cases examined, so that a fourth element in the gait, often overlooked, is a curious drop of the pelvis in walking due to involvement of the lateral abdominal muscles on one side. Normally, if one stands on the right leg and bends the other knee the left side of the pelvis rises, and this occurs at every step in normal walking. If, however, the lateral abdominal muscles are paralyzed on the left side, in standing on the right leg and lifting the left, the left side of the pelvis drops in a similar position to the so-called "Trendelenburg sign," long recognized as occurring in congenital dislocation of the hip. This leads to a complicated limp, which should be recognized, as it can be minimized by a snug fitting corset and exercises, and if overlooked may lead to an unsatisfactory prognosis as to results of operations on the ankle.

If, for example, the patient has a foot drop on the left from paralysis of the anterior leg muscles, and a drop of the left side of the pelvis, walking is complicated, because the patient with foot drop depends on raising that side of the pelvis to clear the ground at the end of the step, and if that side of the pelvis drops and he is unable to raise it, foot drop becomes a very serious handicap in walking.

These four varieties of lameness have been fully discussed because they are so important in influencing the gait, because they are so difficult to remedy by operation, and because they are so often overlooked in formulating the operative plan.

It is a very frequent experience in practice to see a patient who has had an astragalus removed, from which operation he has had a first rate result, and a stable, useful foot, yet who walks practically no better than he did before, because the most serious part of his original lameness was paralysis of the gluteus medius muscle. Under such conditions the parents are likely to be profoundly disgusted with the functional result. It is very difficult to explain to them why they were not told that, although the foot would be better, the lameness would continue about the same.

It may be hard for general surgeons to appreciate the extreme attitude adopted by certain orthopedic surgeons with regard to the operative question. I quote from an article advocating astragalectomy (7): "During the last 6 years I have used astragalectomy . . . . in almost all the deficiencies following infantile paralysis affecting the leg. Altogether my series comprises 135 cases . . . . the results obtained with astragalectomy have led me to discard, except in rare cases, all other procedures."

To sum up, then, my point of view with regard to the operative treatment of infantile paralysis is that all operative procedures

should be undertaken only after a careful study of the gait, that is of the case as a whole, and that operations upon the thigh and leg should not be undertaken in the presence of severe involvement of the hip and abdominal muscles, without warning the parents, or the patient, that the hip and abdominal lameness will not be materially affected by the remedy of the condition existing below.

Bearing in mind then the fact that affection of the hip and abdominal muscles must be identified and carefully taken into account before any attempt by operative means is made to improve the lameness of the patient, we may now pass on to a consideration of the routine proceedings in general use today for the betterment of the function of the knee, lower leg, and foot.

Tendon transplantation. After a long period of discussion, tendon transplantation has emerged as a useful and brilliant operation in selected cases. It is a strictly anatomical problem in every case, and muscular balance must be carefully studied and correctly estimated if the results are to be satisfactory. Simple operations have replaced the earlier complicated procedures and definite rules have been formulated: it is not wise in general to substitute flexors for extensors, the transferred muscles must never pass over the dead center of the joint, should not turn sharp corners, and small muscles do not form satisfactory substitutes for large ones. Personally I have followed the method of Lange in transplanting the tendon in the subcutaneous fat tissue, but the method of Biesalski, Mayer, and Steindler, has much to commend it. In this latter technique the transplanted muscle is put in the sheath of the one which it is to replace, but it is more complicated and not available in all situations. The results of the subcutaneous fat tissue route are highly satisfactory. Adhesions between the tendon and its surroundings rarely occur and when failure of function results, it is more often due to pulling of the tendon out of its insertion than to adhesions. The method of sewing the transplanted tendon to the tendon for which it is to be substituted has been abandoned and insertion into the periosteum often pulls out. To obtain the best and surest fixation, tendons should be inserted into a hole in the bone, carefully stitched through the bone, and a periosteal flap turned up on both sides of the bone incision, which should be sewed also to the tendon.

The silk, which has proved most satisfactory in use after an extended trial of all methods of preparation, is ordinary twisted silk prepared by boiling for one-half hour in a 1:1000 solution of corrosive sublimate. It is then dried in a sterile towel and boiled with the instruments at the time of operation. It has proved less irritating than any other form of silk. Fixation is continued for 3 or 4 weeks, after which light massage is begun, and skillful muscle training should be started 4 or 5 weeks after operation if it can be obtained. There is danger of overusing the transplanted muscle when exercise is first begun. The greatest risk, in my experience, in properly performed tendon transplantation is in allowing the weight of the foot or the weight of the body to come upon the transplanted muscle before it has been well developed by muscle training to a point when it is obviously ready for function.

The transplantations, which, in my experience, have been most satisfactory are the transplantation of the extensor proprius hallucis to the metatarsal bone in mild valgus, the transfer of the peroneus longus to the inner side of the foot in severe valgus, the tibialis anticus to the outer side of the foot in varus, and the insertion of the tibialis posticus and one of the peronei into the os calcis in calcaneus.

Tenodesis or tendon fixation (2). The sewing of the paralyzed tendons of the ankle into grooves in the bone, thereby converting them into suspensory ligaments has proved on the whole satisfactory. Sometimes they stretch or pull out, but in the main, properly performed tenodesis works out well. Foot drop may thus be checked by sewing the tendons at the front of the ankle to the anterior surface of the tibia, varus may be corrected by sewing the peroneals into the fibula, valgus may be improved by sewing the tibialis posticus and anticus into the tibia, and calcaneus by the use of the gastrocnemius as a ligament sewed into the posterior surface of the tibia. To cor-

rect calcaneus by sewing the tibialis posticus and one of the peroneals into the tibia or fibula is likely to produce marked cavus, because these muscles act in this case as flexors of the mediotarsal articulation. In general the use of posterior tenodesis is less satisfactory than the other forms of the operation because the tendon in this position must bear the whole thrust of the body weight at each step, and too often stretches under these conditions.

Silk ligaments (4). After extensive experience in the use of silk ligaments I have personally given them up in favor of other methods of fixation. The silk was too apt to cut out and sometimes to break, and although in a series of reported cases I was able to find a fair number of very satisfactory results, the proportion of unsatisfactory ones was sufficiently large to make it seem that the operation was not worth while, as it meant a long period of fixation and a doubtful result at the end.

Fascia transplants. The use of free fascia transplants to serve as ligaments has been tried on a small scale, but not over a sufficiently long period to report definitely on the results. They have seemed on the whole favorable. Our early technique was, I think, not good, but at present we remove from the fascia lata a sufficiently tough piece of fascia, roll it up, and insert it firmly into the bone at both ends.

Arthrodesis. For stabilizing the ankle, in cases of flail ankle and to correct marked deformity, arthrodesis was formerly used. This consists in opening the ankle joint and removing the cartilage from the tibia and astragalus, to produce ankylosis; but foot-drop at the mediotarsal joint occurred unless these were also ankylosed. Even in a good result the foot is still troublesome in walking up and down hill and allows no motion sideways. The operation has been largely abandoned and should never be done in young children, as serious deformity often occurs in later years in such cases.

Astragalectomy. A very popular operation today, and one which is being done on a very large scale, is astragalectomy, with backward displacement of the foot on the tibia, which is most essential. This most useful operation is in my opinion being greatly abused, as a result of which a great many bad ultimate results are being developed. The results when they are bad are extremely bad, and leave a foot which is more or less stable at the ankle, but where there is a twist of the forefoot resulting in a varus in front of the ankle-joint a twisted foot bearing heavily on the outer border. I speak of this matter with some confidence, because in the public clinics with which I have been associated in New York, Vermont, and Massachusetts, we have had some 5000 cases pass through our hands, and a great many of them were old cases. I had therefore an opportunity to observe a large number of operative results in the later stages, which do not often fall in such large numbers under the eye of the operating surgeon.

The reason for this late occurrence of serious deformity, in cases apparently doing well in the early stages, seems to be this: the growth of the foot is the result of the growth of a number of bones, each furnished with epiphyses. The normal foot of the adult is obtained by the balance of this epiphyseal growth and the sum of the growth of the epiphyses results in the normal balanced foot. If now, the equation is disturbed by the removal in early childhood of so important a factor in the equation as the astragalus, distorted growth, it seems to me, is not an unexpected result. My experience has never led me to feel that astragalectomy should be performed in young children, except in cases of severe calcaneus, for which the operation was originally devised by Whitman (10, 11), or in connection with really serious and threatening deformities of other types. Performed after the age of 14 years, it seems to me to be an admirable operation where operation is necessary. It gives a stable foot with little motion at the ankle-joint, and in skillful hands a good ultimate result is easily obtained by proper technique, but this I believe is not generally the case in young children.

The operation is easy. A Kocher incision, or some similar one, is made below the external malleolus and the foot dislocated inward. The ligamentous attachments of the astragalus are then divided and the astragalus pulled out. An essential part of the operation con-

sists in freeing the inner and outer malleolus subperiosteally upward for an inch or more from the ligamentous attachments, as otherwise the foot cannot be slid backward so far as is necessary for stability and good function. The foot should be fixed in a position of slight equino valgus.

Subastragaloid arthrodesis. With this operation I have not had sufficient personal experience to speak of its value. It consists in a horizontal section of the tarsal bones below the astragalus and a sliding back of the lower section on the upper.

PARALYSIS OF THE UPPER EXTREMITY

With regard to operative treatment of paralysis of the upper extremities, the same considerations pertain as in the case of the leg with regard to securing the maximum amount of function, and these considerations are not always kept in view. The function of the lower extremities is weight bearing and progression in walking, and the two essential functions of the arm are grasping with the hand, and moving the arm in its relation to the body. The briefest considerations will show that flexion power in the hand and fingers is necessary for the performance of manual labor, the trades, the arts, and the routine of domestic life. All the tools used by the laborer must be grasped by the fingers, and there is no trade or occupation dependent upon the use of the extensors. Such simple matters as dressing, eating, writing, knitting, sewing, and similar occupations are all dependent upon flexor activity. For this reason it is of no use to consider operation in cases in which flexion power of the fingers is lost. But in addition to flexion power in the fingers, for useful function it must be possible to move the scapula on the thorax, which implies a fair degree of power in the rhomboids, trapezius, and serratus muscles. These two things then constitute the minimum requirements for a successful operation on a paralyzed arm: (1) flexion power of the hand and fingers, and (2) ability to move the scapula on the thorax.

The flail arm is perfectly hopeless and nothing can be done.

Deltoid paralysis. The deltoid muscle is required to raise the arm from the side, and with regard to its preservation, a very different class of results have been seen in paralysis of the shoulder since the arm has been supported from the outset by an aeroplane splint to do away with the drag of the arm on the deltoid, so that paralysis of the deltoid has become much less formidable.

Tendon transplantation. In my experience muscular transplantations to substitute for the deltoid have been almost uniformly unsatisfactory. I have never seen in my own experience, or in that of others, a really good result from this operation. The trapezius has been transplanted into the humerus with a view of securing abduction of the arm, but most of these cases have resulted in failures. The origin of the pectoralis major muscle has been detached from the chest, swung over the shoulder, and sewed into the spine of the scapula. In this operation some improvement in abduction has occasionally resulted, but in both of these cases the function secured has been on the whole poor.

With regard to the restoration of function: first, the motion of the arm on the body must be secured and the best operation in cases of deltoid paralysis to secure abduction of the arm is *arthrodesis* of the shoulder-joint. This operation, however, is of course only effective where the muscles which move the scapula on the thorax are of good power. After a successful arthrodesis of the shoulder-joint, with good trapezius, serratus, and rhomboid muscles, if the arm is put up in abduction and somewhat forward of the plane of the body, a very useful arm results, with good motion and good power. The operation is not, I believe, in general to be undertaken in early childhood, because the parts of the joint are then so largely cartilaginous that a certain proportion of failures in securing ankylosis results.

If the biceps muscle is paralyzed in connection with shoulder-joint paralysis, *arthrodesis of the elbow* is also desirable. The biceps muscle must be regarded as one of the highest importance in the function of the arm, and time is often spent in developing a hopelessly bad deltoid by muscle training when the effort would be better spent in attempting to save and develop a promising biceps.

There remains to be dealt with the second requisite for proper function, namely, flexion power in the fingers and wrist. Fortunately for the patient the hand escapes in all but the severest cases, and paralysis of the shoulder is much more common than paralysis lower down. *Tendon transplantation* in the hand is often of use particularly with regard to the muscle of the thumb, where the opposing action of the thumb and forefinger is most desirable. No rules can be laid down for the performance of these operations and they must be worked out on anatomical grounds.

An arm with a stiff shoulder-joint and a stiff elbow, with flexor power in the wrist and fingers and sufficient power in the scapular muscles to move the arm about is a fairly useful arm, and infinitely preferable to the arm which hangs helpless at the side.

SUMMARY

This very briefly comprises my experience in the operative treatment of infantile paralysis. I believe that our greatest defect is in not realizing that operation must always be directed to securing better function and that function can only be studied by taking the case as a whole and analyzing it to see where function is defective and how it can be improved. It may be that mechanical treatment will offer the best hope in the individual case; if so, it should be used. If operation can effect improvement it should be done, often both operative and mechanical treatment will be desirable. The function of the lower extremity is walking, and improvement in walking cannot be brought about by operative measures which do not attack the chief factor of the lameness. In the upper extremity the hand must be able to grasp and the shoulder to be moved on the body to justify operation. In the absence of either one of these no good function will result from operation.

Having made the analysis of function, the salient features of the case should be picked out, and if there is a reasonable prospect of relief by operation, then the operation should be performed promptly and the two-year period of waiting prescribed by earlier writers is not necessary in all cases. I should deprecate especially the performance of serious structural operations upon the foot when the chief cause of the limp lies in the muscles of the hip and abdomen. These operations may well be necessary, and if so, should be performed, but not with the expectation of remedying a limp of which they are not the cause.

If the operative aspect of infantile paralysis is approached from this functional point of view, we will operate more intelligently, more radically, and more fearlessly, but will leave undone a good many operations which at present are done without a sufficiently detailed study of the case, or a sufficient reflection on how much improvement in function is really going to be effected by the proposed operation.

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CARCINOMA OF THE PROSTATE

A Clinical Study[1]

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THE comparatively recent introduction of radium as a therapeutic agent has centered medical interest around the various aspects of the treatment of carcinoma of the prostate, and current literature abounds with reports of cases thus treated. Whereas formerly the frequency of the disease, the clinical findings, the results of its surgical treatment, and the prognosis were almost established facts which the occasional atypical case but served to emphasize, now the entire progress of the disease has become altered by the therapy and all the various phases of the disease are opened again to new investigation. Because of this fact, it seems pertinent to emphasize a phase of the disease that has received less study than many other aspects. I refer to the occurrence of metastasis, the frequency of which does not seem to be fully appreciated. Although as early as 1854 Sir Henry Thompson reported a case of osseous metastasis from a primary growth in the prostate, Blumer 55 years later was able to collect only 43 such cases from the literature. That the occurrence of metastasis is important, no one will deny. That it may be present without producing symptoms and that it may be present when the gland is not appreciably or only slightly enlarged are facts which I wish particularly to emphasize, for unless the presence of such metastasis is carefully ruled out by thorough roentgenologic study, or, when the roentgenograms are negative, by careful neurological examination, reports of results of any form of therapy in carcinoma of the prostate are subject to criticism, and deductions drawn from them are open to doubt. In order to call attention to these points, a careful study has been made of the 362 cases of carcinoma of the prostate observed at the Mayo Clinic during the years 1914 to 1919 inclusive. Of these, 79 (21 per cent) showed evidence of metastasis. A comparative study of the group with metastasis and of the group without metastasis forms the basis of this paper.

Lymphatic Drainage of the Prostate

A study of metastasis necessitates a knowledge of the lymphatic drainage of the prostate. The belief that carcinoma of the prostate does not readily invade the lymphatics is probably due to a lack of such knowledge, since it was not until 1902 that the several drainage routes in man were known (Cunéo and Marcille). In order fully to understand this drainage, the lymphatics of the pelvis must be studied. They consist of three main groups named from the great vessels about which they are situated: the external iliac glands, the internal iliac glands, and the common iliac glands.

"The lymphatics of the prostate arise by fine capillaries arranged in the form of a network around each glandular acinus. From these periacinous networks run larger vessels which pass toward the periphery of the gland and form at its surface a second network, the periprostatic network, from which the collectors start to drain in four different directions. One collector starts from the posterior surface of the prostate and ascending on the posterior superior surface of the bladder, curves sharply outward, crosses the internal iliac artery, and terminates in the external iliac group of glands midway between the crural arch and the bifurcation of the common iliac artery."

A second collecting trunk draining the posterior surface of the gland accompanies the prostatic artery and terminates in the internal iliac group. A third and a fourth set which arise from the posterior surface, run downward and then upward across the lateral surface of the rectum, and ascend on the anterior surface of the sacrum, the shorter external trunks ending in glands of the internal iliac group situated internal to the second or third

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TABLE I.—METASTASIS IN GLANDS

Patients with metastasis		Percentage in 79 patients with metastasis	Percentage in total number —362 patients
In glands	37	46.1	10.2
Inguinal glands	20	25.3	5.5
Iliac glands	12	15.1	3.3
Cervical glands	9	11.3	2.5
Left cervical glands	7	8.9	1.9
Retroperitoneal glands	5	6.3	1.4

sacral foramen, and the larger internal trunks terminating in the common iliac group on the promontory of the sacrum. A descending trunk on the anterior surface of the gland, after uniting with vessels from the urethra, empties into the internal iliac group. The lymphatic glands of the external and internal iliac groups drain into the common iliac glands, which in turn empty into the abdominal aortic glands which constitute a continuous vertical chain (Fig. 1).

METASTASIS TO THE GLANDS

It is apparent that glandular invasion from carcinoma of the prostate can be very extensive without giving physical signs, and that lymphatic involvement cannot be demonstrated until the glands have enlarged sufficiently to become palpable through the abdominal wall, or have increased to such size in the pelvis that they can be reached by the examining finger in the rectum. This knowledge possibly explains the discrepancy in the incidence of glandular involvement given by various authors. Young reported a series of 111 clinical and surgical cases with glandular involvement in but 20 per cent; he states that he believes these figures prove the infrequency of such involvement. Pasteau found glandular involvement at necropsy in 85 per cent of 71 cases; in 30 per cent the inguinal glands were involved. Kaufmann reports metastasis in 50 per cent of 100 necropsies found in order of frequency in the iliac glands, the inguinal glands, the glands of Scarpa's triangle, the axillary glands, the femoral glands, and the cervical glands.

In our series of 362 cases of carcinoma of the prostate, metastasis was found in 79, 21.8 per cent; in 37, 10.2 per cent, the glands were involved (Table I).

The low percentages of glandular metastasis noted clinically contrasted with the high

TABLE II.—LOCATION OF PAIN IN 27 CASES OF CARCINOMA OF THE PROSTATE WITH METASTASIS

	Cases
Pain as first symptom	27
Thigh and back	5
Back	5
Thigh	4
Back and chest	3
Rectum	2
Chest	2
Abdomen	2
Chest, back, and thigh	1
Chest and thigh	1
Thigh and inguinal region	1

percentages in postmortem reports indicate that glandular involvement occurs generally in the terminal stages of the disease. This is unquestionably true of involvement of the inguinal glands which probably occurs after that of all the deep lymphatics. The conclusion that glandular involvement is infrequent or late because of the low percentage of cases in which it is found clinically is erroneous, I believe, and if the iliac glands could be examined satisfactorily their early involvement would undoubtedly be proved. The fact that pain is often an early symptom of the disease, occurring as the first symptom in 34.1 per cent of our cases with metastasis, seems to point to early metastasis. The assumption is especially warranted when the pain is in the back, chest, or abdomen, where its occurrence can be explained only as pressure from metastatic growths on nerve roots and not as pressure from local extension, as in the case of sciatic, rectal, and perineal pains. Table II bears out this argument.

In many cases the pressure producing even this sciatic pain is probably not the result of an increase in the size of the gland, but of the pressure from the involved regional lymphatics

TABLE III.—PAIN

Patients with metastasis with pain—60, or 75.9 per cent of 79.

Patients with metastasis without pain—19, or 24.1 per cent of 79.

Patients without metastasis with pain—97, or 34.3 per cent of 283.

Patients without metastasis without pain—186, or 65.7 per cent of 283.

Total number of patients with pain—157, or 43.3 per cent of 362.

Total number of patients without pain—205, or 56.3 per cent of 362.

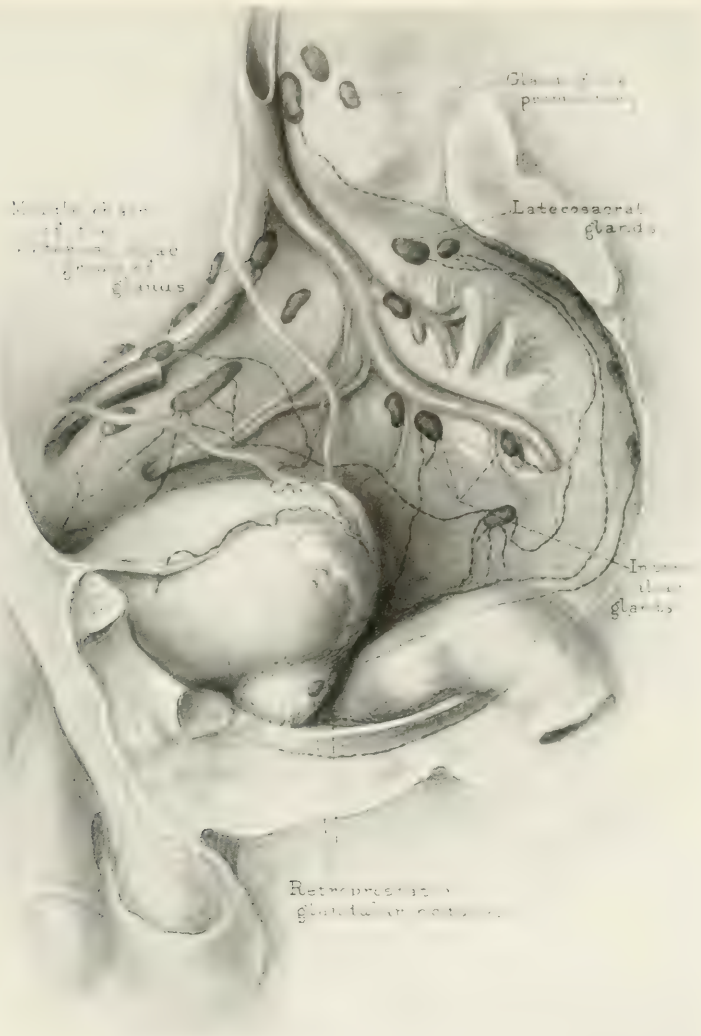

Fig. 1. Lymphatic drainage of the prostate gland and first lymphatics to become involved in carcinoma of the prostate.

on the sacral promontory. This fact is emphasized further by the numerous cases in which the roentgen-ray failed to show any bony changes, although the nerve root pains were so severe that they could be accounted for only on the grounds of pressure from involved glands along the sides of the vertebræ. In fact, it is extremely doubtful whether or not metastasis produces pain unless it exerts pressure on nerve roots or interferes with joint function. Several of our patients showed extensive bony destruction but had no history of pain. In one case the entire ascending ramus of the ischium of the same side was destroyed (Fig. 2) but the patient complained of pain only when he moved the hip-joint. Extensive glandular metastasis may also occur without pain; several of our patients who had no pain had iliac retroperitoneal and cervical metastasis. The general metastatic involvement shown in Figure 3 was painless until the cervical involvement (Fig. 4) had become so great that the lymphatic drainage to the tongue was blocked and the resulting œdema caused

the lower teeth to cut into the tongue's under surface. Pain is by no means a major symptom of the disease, as in our entire series its absence was noted oftener than its presence. As was expected it occurred more frequently in the cases with metastasis (75.9 per cent), than in those without (34.3 per cent), but even in one-fourth of the cases with metastasis, the patients were free from pain. Table III gives the incidence of pain as a clinical symptom.

PATHOLOGY

Cancer of the prostate may be primary in the gland; more frequently it is associated with simple hyperplasia. Judd found hypertrophy with cancer in 75 per cent of his cases, while Wilson and McGrath report their association in as high as 83 per cent of a series of cases. Whether the carcinoma in these cases is the end-result of a transitional change beginning in the hypertrophied gland or a primary condition developing in conjunction with simple hyperplasia is a question which was first discussed by Albarran and Halle in 1891. They believed that carcinoma results from malignant degeneration in simple hyperplasia, and held that a definite relationship exists between the two conditions. They described a microscopic picture to which they gave the name of "epithelioma adenoid," which they believed represented various stages in this malignant degeneration, and reported its occurrence in 10 per cent of the prostates with benign lesions examined by them. Since their report has appeared, however, other investigators have found similar cell masses in tissues which were unquestionably benign so that the theory is now generally discredited. Moreover, carcinoma nearly always develops in the posterior lobe, although in some cases other lobes are the first to be involved in hyperplasia.

Two types of carcinomatous prostates. Clinically, carcinoma of the prostate presents two fairly typical types of enlargement, although many intermediate types occur. In Type 1 the gland is so slightly enlarged and gives so few local symptoms that it is often discovered only because of symptoms produced by metastasis. Even in the late stages of the disease, the local growth does not become extensive. The enlargement is generally uniform, without any of the irregularities of contour presented by the common type of carcinomatous gland. Characteristic, stony, hard areas are absent as a rule. Although there may be localized areas of greater density, the gland as a whole presents a lack of resilience rather than a stony hardness and resembles true inflammatory hypertrophy with which it is often confused, although in the latter case resilience is not lost. The gland is never so large that it cannot be outlined by the examining finger. In the more common type of carcinomatous prostate (Type 2) the gland may present any degree of enlargement according to the duration of the disease, but the topography encountered by the examining finger is always the same, irrespective of variations in size. The contour of the gland, palpated through the uninvolved rectal mucosa, is irregular, the surface is elevated at different points by masses, which, when examined individually, fail to give any sense of elasticity and have been characteristically described as of a stony hardness. These masses of carcinoma, palpated through the normal or hypertrophic gland, compressed as a result of their growth, resemble nothing so much as the pit of a plum felt through the unripe fruit. As the disease advances these areas coalesce and the entire gland assumes this stony hardness, but if examination is made early in the disease, the involvement may be felt as individual areas. Because carcinoma of the prostate is primarily an infiltrating growth and produces destruction and necrosis only in its later stages, the localized growth becomes large. It spreads upward into the seminal vesicles beneath Denonvillier's fascia (which extends from the triangular ligament over the posterior surface of the prostate to the peritoneum as a tense fascial plane covering the prostate and vesicles), at first involving the soft tissues adjacent to the ejaculatory ducts and lower end of the vas deferens beneath the bladder trigone, and later invading the interior of the vesicles. This method of extension results in a unicornate or bicornate growth, depending whether one or both vesicles are involved, often so large as to cause considerable rectal

obstruction, and in the terminal stages not only obstructing the bowel and making impossible any accurate determination of its extent by rectal palpation, but also involving the entire pelvis and often palpable suprapubically. The rectal and urethral mucosa is broken through only in the later stages, a fact which explains the very low incidence of hæmaturia. Only 1.3 per cent of our 362 patients named hæmaturia as a first symptom and it occurred grossly at any time in only 12.7 per cent.

The only means approaching accuracy in determining the percentage of occurrence of the two types of diseased glands is a classification in which the sizes of the glands are given on a scale of 1, 2, 3, and 4. All Type 1 glands are graded 1, and Type 2 glands are graded 2, 3, and 4. Naturally early cases of Type 2 glands are sometimes grouped with Type 1 glands. Type 1, size 1, glands were found in only 24 cases (6.6 per cent) of the series, Type 2, size 2, in 74 (20.4 per cent), size 3 in 93 (25.7 per cent), and size 4 in 110 (30.3 per cent); the size was not given in 16 case histories. In the Type 1 glands, however, the disease metastasizes earlier and spreads more rapidly than in the larger glands.

Microscopic examination. Microscopically, carcinoma of the prostate presents varied pictures, but microscopically as well as clinically in the two types are all intermediate gradations. Specifically the neoplasm is an adenocarcinoma. In the Type 1 carcinomatous prostate, the cancer cells are scattered throughout a somewhat increased fibrous stroma and show almost no tendency to glandular formation. Figure 5 illustrates this tendency to infiltrate throughout the gland and shows how closely this type of carcinoma resembles scirrhous carcinoma of the breast, from which, unless the origin of the specimen is known, it is difficult to distinguish. The Type 1 gland is far more malignant than the more frequent Type 2. This is evidenced clinically by the percentage of occurrence in cases with pain as the first symptom, if pain is considered the result of metastasis. Size 1 glands occur on an average in 6.6 per cent of all cases and almost twice as often (11.1 per cent)

Fig. 2. (311469) Roentgenogram showing destruction of ascending ramus of ischium from osteoclastic metastasis.

in the cases with signs of early metastasis, that is in which pain is the first symptom. Sections from Type 2 glands show cuboidal, columnar, and undifferentiated cancer cells, crowding poorly formed gland acini, and in places breaking through into the stroma, where they collect in groups of undifferentiated cancer cells. Even in such groups, however, are found attempts at acinus formation (Fig. 6).

Radiumtherapy. There is little doubt that of the two types the smooth, firm, well encapsulated carcinoma, which on rectal examination because of its small size seems to present ideal conditions for obtaining gratifying results with radiumtherapy, offers the graver prognosis. Probably better results may be obtained from treating the larger type of growth prior to the occurrence of metastasis which takes place late in such cases. Even when the small gland is treated early, it is doubtful whether so good a result may be obtained as in the large gland because of the potential malignancy of the cancer cells in the former.

Fig. 3. (279878) Marked metastasis to the inguinal and cervical glands and to the skin in a patient with carcinoma of the prostate. The patient's inability to close his mouth is due to œdema of the tongue resulting from a mass of enlarged glands in the submaxillary region. Note the huge mass of glands in the left cervical region. An X-ray of the skeleton did not reveal any osseous metastasis.

METASTASIS TO THE BONES

The first case of metastasis to the bone in carcinoma of the prostate was reported by Thompson in 1854. The patient, a man of 60, complained chiefly of frequent and difficult urination. Within a few months paraplegia developed gradually and finally resulted in loss of all sensation up to the armpits. Postmortem examination showed the prostate to be involved in a carcinomatous mass the size of an orange. Some of the adjacent glands were also involved. The right kidney was pyonephrotic, apparently the result of pressure on the lower ureter. A metastatic growth was found adherent to the first dorsal vertebra with similar small growths in the lower vertebræ which accounted for the paraplegia. In the second case, reported by Silcock in 1884, metastasis to the femur resulted in spontaneous fracture and deposits in the cranial bones, producing central nervous system manifestations. Two of the patients in our series suffered spontaneous fractures of the femur late in the disease.

Osteoplastic and osteoclastic metastasis. The first complete work on metastasis to the bone in carcinoma of the prostate was published by von Recklinghausen in 1871. He compared the bony metastasis with fibrous osteitis and showed that the process is primarily an infiltration and so resembles inflammatory changes that he felt justified in terming it "carcinomatous osteitis." He called attention to the fact that metastasis begins in the medullary portion of the bone and spreads out, and that new bone formation is always more prominent, while the destructive character of the tumor remains in the background. We know this to be true in the majority of cases, but that osteoclastic changes may also occur is shown in Figures 2 and 7 which illustrate the complete destruction of much of the ischium. The patients complained of no urinary symptoms, and the very small, smooth, hard prostates were discovered only as a result of routine rectal examinations. The roentgenogram shown in Figure 7 was made in order to rule out the possibility of metastasis as the etiologic factor in a unilateral sciatica.

Von Recklinghausen reported 6 cases of metastasis in his series, naming the vertebræ, femur, pelvis, ribs, sternum, skull, fibula, radius, and ulna in order of involvement. Blumer, in a collective report of the cases recorded in the literature up to 1909 and two of his own (43 cases), tabulated the frequency of involvement of the bones as follows:

	Cases
Vertebræ	35
Ribs	30
Pelvis	26
Femur	25
Skull	18
Sternum	16
Humerus	15

Since these cases represent necropsy findings they are of little value from a clinical standpoint, for there is no doubt that osseous metastasis occurs in the majority of cases.

Carlier and Davrinche give an incidence of osseous metastasis which approaches that in our cases:

	Cases
Vertebræ	17
Pelvis	13
Femur	11
Ribs	8
Sternum	8
Head	6
Humerus	6
Scapula	6
Tibia	3
Clavicle	2
Fibula	1
Radius and ulna	1

These authors first called attention to the more nearly accurate statistics of the incidence of metastasis which may be expected from roentgen rather than from clinical examination. As was anticipated, the X-ray findings have been most useful in determining the extent of the lesion. Stewart believes that in the majority of cases the primary growth can be diagnosed by the roentgenographic appearance of the metastasis. He quotes from Phemister:

"Metastasis in bony structure following a primary carcinoma usually assumes the characteristics of the original growth; if the stroma predominated in the primary lesion, we are sure to have a condensing or osteoplastic form of metastasis; if the primary cancer were of a medullary form, we would have a secondary rarifying or osteoclastic process."

Stewart calls attention to the fact that in carcinoma of the prostate the stroma predominates, and a condensing form of secondary lesion should occur. This is in keeping with von Recklinghausen's findings and applies to the majority of cases, but as is evident from Figures 2 and 7 osteoclastic metastasis also occurs.

Incidence and location. Metastasis to the bone was found in 41 of our patients who were X-rayed; they represent 51 per cent of the 79 patients with metastasis, and 30.3 per cent of the 135 patients who were given a roentgen examination.

From Tables IV and V it is apparent that the pelvis, the spine, and the femur (Figs. 8, 9, 10, 11, 12, and 13) are most frequently the site of metastasis. Pulmonary involvement is rare and occurs late in the disease. All 3 patients in whom metastasis was found in the lungs had pelvic and spinal involvement, and in 2 the ribs, and in 1 the femurs were also involved (Fig. 14).

Fig. 4. (279878) Enlarged glands in the left cervical region of patient shown in Figure 3. Metastasis to this group of glands occurred in 8.9 per cent of our cases with metastasis.

TABLE IV.—INCIDENCE OF METASTASIS IN 135 PATIENTS X-RAYED

	X-rayed	Metastasis	Percentage
Pelvis	80	30	37.5
Spine	67	24	35.8
Femur	16	6	31.2
Ribs	86	6	6.9
Lungs	86	3	3.4

TABLE V.—79 PATIENTS WITH METASTASIS

	X-rayed	Metastasis	Percentage
Pelvis	41	30	73.1
Spine	36	24	66.6
Femur	9	6	66.6
Ribs	31	6	19.3
Lungs	31	3	9.7

The figures in these tables also demonstrate that if the spine, the pelvis, and the femurs are rayed routinely in all cases of disease of the prostate suspected of being malignant, the number of cases of metastasis that will not be

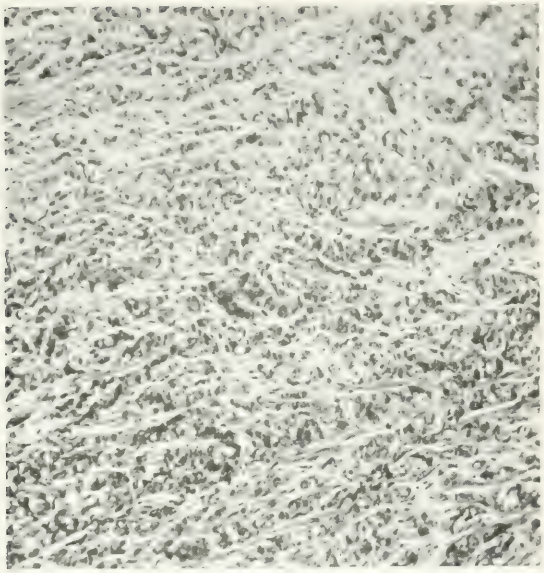

Fig. 5. (20348) Photomicrograph of section from highly malignant Type 1 adenocarcinoma of the prostate of infiltrating type, exhibiting little tendency to glandular formation, but infiltrating through the stroma.

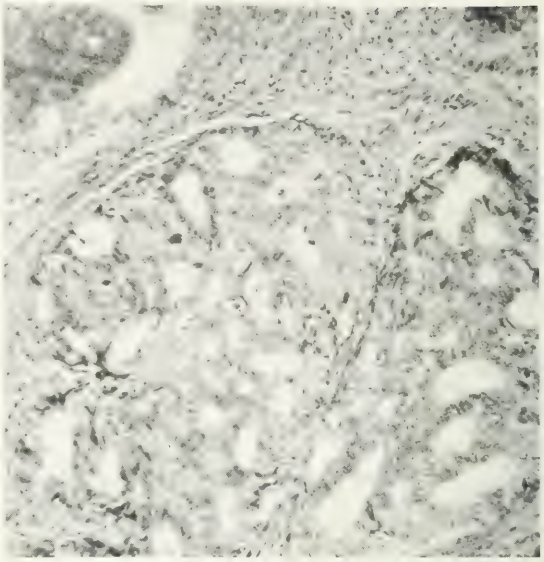

Fig. 6. (38264) Photomicrograph of Type 2 adenocarcinoma of the prostate. Note the tendency of the carcinoma cells to atypical acinus formation and slight tendency of neoplasm to invade surrounding tissue.

discovered will be negligible. It seems unnecessary to ray the lungs as a routine procedure since metastasis to the lungs only probably never occurs.

A comparison of the number of cases in this series with glandular metastasis, with the cases with osseous metastasis, leads to erroneous conclusions, for many patients who had marked glandular involvement were sent home as incurable without being rayed. For this same reason the percentages of occurrence of metastasis are based on the number of patients rayed rather than on the total number of patients. It seems conservative, therefore, to state that 30.3 per cent, or practically one-third of all patients with carcinoma of the prostate, will be found to have osseous metastasis, and in the overwhelming majority of this number metastasis will be found in the pelvis, the spine, and the femurs. Moreover, unless these areas have been carefully rayed, it is useless to draw conclusions on the efficacy of radium treatment or the results of surgery. In 17 of our cases, the spine and the pelvis were both involved; in 21 cases the pelvis was involved with some other structure. Table VI shows the structures involved in the cases in which metastasis was found in one location only.

Spinal cord involvement. Spinal cord involvement occurred in 8 of our cases. In 4 of these the prostate was described as large and nodular, and the cord symptoms occurred late in the disease. In one case history, description of the gland was omitted. In the three other case histories the gland was definitely described as slightly if at all enlarged and of regular contour. In two of these cases pain of a neuralgic character in the chest, particularly about the shoulders, was the first symptom,

TABLE VI.—LOCATION OF METASTASIS IN 40 CASES WITH SINGLE METASTASIS

	Cases	Percentage
Pelvis	9	11.3
Inguinal glands	7	8.8
Cervical glands	5	6.3
Spinal cord	5	6.3
Iliac glands	4	5.06
Spine	3	3.7
Ribs	2	2.5
Femur	2	2.5
Retroperitoneal glands	1	1.2
Skin	1	1.2
Liver	1	1.2

Fig. 7. (311469) Roentgenogram showing destruction of the right ischium as a result of metastatic growth in which the osteoclastic tendency predominates.

Fig. 8. (201980) Metastasis in lumbar vertebræ and pelvis.

followed in a short time by a gradually developing paraplegia. There was no urinary disturbance until after the sphincter control was lost as a result of the lesion of the cord. In the third case in which the patient gave a history of prostatic trouble of several years' duration, pain about the hips preceded the paraplegia by a few weeks. In none of the 3 cases could any evidence of osseous involvement be demonstrated by the X-ray. The clinical picture was that of spinal cord tumor, and only after carefully ruling it out was the primary source of the malignancy found. These cases illustrate how such metastasis may produce pain simulating intercostal neuralgia or aneurysmal pains, and it therefore becomes an important point in the differential diagnosis of chest pains to include metastasis from carcinoma of the prostate. In fact, neuralgia or rheumatic pains developing during "the prostate age" in men who give no previous history of rheumatic infection should excite suspicion, and the prostate gland should be examined even if there is no suggestive urinary history. Pain was foremost in the list of first symptoms and appeared in 34.1 per cent of the 79 cases with metastasis; while in the group of cases without metastasis pain had third place among the first symptoms and occurred in only 12 per cent of the 283 cases. From this it is apparent that lack of a suggestive urinary history by no means rules out the possibility of cancer of the prostate, and that in a third of the cases in which metastasis is found, the first symptoms are not referable to the urinary tract (Table VII).

CLINICAL DATA

The absence of macroscopic hæmaturia as a first symptom in the cases with metastasis compared with its occurrence in only 5 of a large series of cases without metastasis is striking. Another noteworthy difference is the occurrence of retention as a first symptom in only 1 case with metastasis and in 9 cases without metastasis. These two differences are undoubtedly attributable to the same cause, namely, the tendency of the carcinoma in cases without

Fig. 9. (282420) Multiple areas of metastasis in the sacrum and ilia; a common type of metastasis.

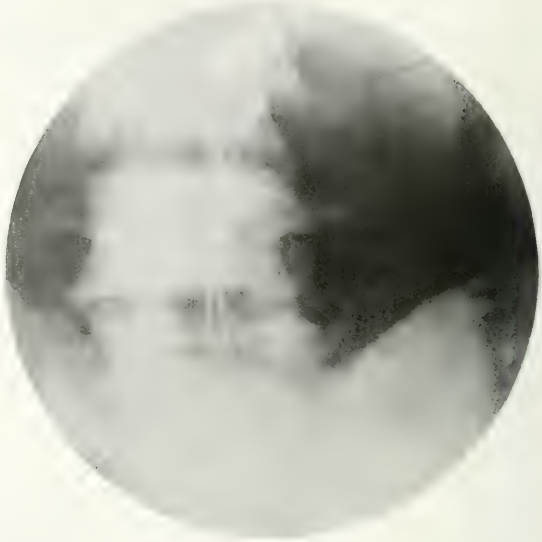

Fig. 10. (195263) Metastasis of the lumbar spine, pelvis, and sacrum.

metastasis to grow locally, producing obstruction, and finally eroding the urethral mucosa, while the small gland (Type 1) found oftener in the cases with metastasis produces little obstruction and results in death from metastasis before erosion has occurred. When the urinary symptoms are studied alone throughout the disease, the same probable causes and general deductions become apparent. Retention occurs in 25 per cent of the cases with metastasis and in 33.9 per cent of the cases without metastasis. Macroscopic hæmaturia, which was entirely absent as a first symptom in the former group, appears as a later symptom in twice as many cases without metastasis as with metastasis. These facts show conclusively the nature of the two types of carcinoma of the prostate; the one exhibits a tendency to remain localized and produce urinary symptoms while the other quickly spreads to various parts of the body, with little tendency to localized growth and results in death from metastasis. Of the patients

TABLE VII.—FIRST SYMPTOMS

	Cases	Percentage
79 patients with metastasis		
Pain	27	34.1
Frequency	22	27.8
Difficulty	13	16.4
Nocturia	9	11.3
Incontinence	2	2.5
Œdema of the legs	2	2.5
Enlarged inguinal glands	1	1.2
Pyuria	1	1.2
Retention	1	1.2
None	1	1.2
283 patients without metastasis		
Frequency	104	36.7
Difficulty	92	32.5
Pain	34	12.01
Nocturia	24	8.4
Retention	9	3.1
Hæmaturia	5	1.7
Incontinence	1	0.35
Weakness	1	0.35
Loss of weight	1	0.35
Pyuria	1	0.35
None	11	3.5

TABLE VIII.—URINARY SYMPTOMS

	Cases	Percentage
75 patients with metastasis		
Frequency	52	65.8
Difficulty	43	54.4
Retention	20	25.6
Nocturia	14	17.7
Hæmaturia	6	7.6
Incontinence	5	6.4
None	9	11.5
283 patients without metastasis		
Frequency	183	64.6
Difficulty	188	66.4
Retention	96	33.9
Nocturia	74	26.1
Hæmaturia	40	14.1
Incontinence	17	6.1
None	11	3.8

Fig. 11. (181438) Extensive metastasis of the lumbar spine, sacrum, and ilia.

Fig. 12. (181438) A condensing form of secondary lesion with extensive osteoplastic metastasis in the pelvis and femur.

with metastasis 11.5 per cent have no urinary symptoms in comparison with 3.8 per cent in the patients without metastasis (Table VIII).

Although hæmaturia occurs macroscopically twice as often in cases without metastasis, urine analysis fails to confirm this point, for blood is detected microscopically in the same percentage (32 per cent) of cases in both groups. Its absence, however, is noted twice as often as its presence. Table IX also demonstrates the greater freedom from urinary disturbance in the patients with metastasis, normal urine being found in 46.8 per cent, as compared with 35.9 per cent in the patients without metastasis. The occurrence of pus, always the best index to urinary disturbance, is 11.52 per cent higher in the cases without metastasis.

The differences in the findings of the two groups are confirmed by the amounts of residual urine found; the average in the cases with metastasis was 3.7 ounces, in the cases without metastasis, 6.9 ounces, still further evidence of the greater tendency to urinary difficulty in the latter group.

The age of the patients and the duration of the disease correspond closely to the statistics of other authors. Walker gives the average age as 65 years. In our series it was 64.8 years; the average age of the patients with metastasis was 63, and of those without metastasis 66. The age of one patient was not given. The ages by decades were as follows:

	Number	Percentage
Patients from 40 to 49 years	10	2.7
Patients from 50 to 59 years	78	21.6
Patients from 60 to 69 years	185	51.2
Patients from 70 to 79 years	80	22.1
Patients from 80 to 89 years	8	1.2

The average duration of life of the patients the date of whose first symptoms and date of death were definitely known was three and one-half years. The duration of the disease in patients with metastasis and in patients

TABLE IX.—URINALYSIS

79 persons with metastasis		
Urinalysis	47, or 59.19 per cent of	79
Blood in urine	15, or 31.91 per cent of	47
Without blood in urine	32, or 68.09 per cent of	47
Pus in urine	23, or 48.93 per cent of	47
Without pus in urine	24, or 51.06 per cent of	47
Negative urine	22, or 46.8 per cent of	47
283 persons without metastasis		
Urinalysis	181, or 63.95 per cent of	283
Blood in urine	58, or 33.91 per cent of	171
Without blood in urine	113, or 66.08 per cent of	171
Pus in urine	107, or 60.45 per cent of	177
Without pus in urine	70, or 39.54 per cent of	177
Negative urine	65, or 35.91 per cent of	181

Fig. 13. (288379) Metastasis in the ribs.

Fig. 14. (194448) Area of metastasis in right lung.

without metastasis and in the reference to the type and size of the gland is based on data obtained from patients who were not treated surgically or with radium.

Fenwick estimated the average at 3 years. The average duration of disease of our 41 patients with metastasis who were traced was 2.7 years, of the 171 patients without metastasis, 3.4 years (Table X). This slight difference is suggestive but not convincing of a greater duration of life of patients in whom metastasis is not found on examination. The length of time is probably much the same for the majority of patients with carcinoma of the prostate (Table XI), and metastasis probably occurs ultimately in all cases. The type of gland, not the presence of metastasis, determines the course of the disease (Table XII), and in cases with Type 1 glands the duration of the disease is undoubtedly shorter, due to the early metastasis. Because of the infrequency of this type of gland we have been able accurately to determine the duration of the disease in but 3 cases, and this number is too small from which to draw definite conclusions.

TABLE X.—AGE AND DURATION OF DISEASE IN 362 PATIENTS WITH REFERENCE TO METASTASIS

	Years
Average age of 362 patients	64.5
Average age of 79 patients with metastasis	63
Average age of 283 patients without metastasis	66
Average duration of disease in 16 untreated patients with metastasis	2.73
Average duration of disease in 71 untreated patients without metastasis	3.4

CONCLUSIONS

1. Metastasis to the glands probably occurs more frequently in cases of carcinoma of the

TABLE XI.—DURATION OF DISEASE IN 92 UNTREATED CASES

	Cases	Percentage
Less than 1 year	8	8.7
1 year or more	21	22.8
2 years or more	15	16.3
3 years or more	14	15.3
4 years or more	3	3.3
5 years or more	9	9.8
6 years or more	1	1.1
7 years or more	1	1.1
10 years or more	4	4.3
Not given	16	17.4

TABLE XII.—SIZE OF GLANDS IN 215 UNTREATED CASES ON A SCALE OF 1, 2, 3, 4

		79 cases with metastasis		136 cases without metastasis		Cases traced	Duration of disease
Size 1	11, or 5.1 per cent of 215	8	10.1 per cent of 79	3	2.2 per cent of 136	3	2 years, 11 months
Size 2	36, or 16.7 per cent of 215	14	17.7 per cent of 79	22	16.2 per cent of 136	13	4 years, 4 months
Size 3	48, or 22.3 per cent of 215	17	21.5 per cent of 79	31	22.8 per cent of 136	18	3 years, 2 months
Size 4	74, or 34.4 per cent of 215	19	24.1 per cent of 79	55	40.4 per cent of 136	33	3 years, 4 months
Size not stated	46, or 21.4 per cent of 215	21	26.5 per cent of 79	25	18.4 per cent of 136	25	

prostate than is demonstrable clinically because of the inaccessibility of the glands first involved.

2. Two distinct types of carcinoma of the prostate are distinguishable clinically and microscopically.

3. The smaller type of carcinoma of the prostate gives clinical and microscopic evidence of greater malignancy.

4. The larger type of carcinoma of the prostate tends to remain localized, resulting in more urinary symptoms and producing metastasis later in the disease than the smaller clinical type.

5. The larger clinical type of carcinoma of the prostate is more amenable to radiumtherapy because of its lesser potentiality of malignancy.

6. One-third of the patients with carcinoma of the prostate have osseous metastasis demonstrable by the roentgen-ray.

7. The pelvis and spine are the most frequent sites of osseous metastasis.

8. Metastasis occurs rarely in the lungs, probably never without involvement elsewhere.

9. Metastasis to the spinal cord from carcinoma of the prostate closely simulates primary cord tumors and often occurs when the prostate is but slightly enlarged.

10. Pain is absent in one-fourth of all cases with metastasis.

11. Urinary symptoms are absent in 11.5 per cent of all cases with metastasis.

12. Neuralgic and rheumatic pains in men above middle age, even in the absence of urinary symptoms, should suggest the possibility of carcinoma of the prostate.

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URINARY CALCULUS AT THE CANTON HOSPITAL, CANTON, CHINA[1,2]

Based Upon Three Thousand Five Hundred Operations

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HISTORICAL

In 1835, Peter Parker, M.R.A.S., a graduate of Yale University, the first missionary physician to China, who "opened China at the point of a lancet," founded the Ophthalmic Hospital, subsequently called the Canton Hospital. The first lithotomy operation upon a Chinese was performed by Parker on July 17, 1844. The patient was a male, age 35, resident in Canton. The calculus weighed 1 ounce 1 drachm, and measured 5½ by 3½ inches in circumference. In 9 days the urine ceased to flow from the wound and at the end of 18 days the patient was discharged cured. The year previous lithotrity was attempted, but the operation was not completed.

Sulphuric ether was first used in this hospital in the year 1847, and chloroform in 1848.

Parker's collection of calculi removed from patients in the Canton Hospital was donated by him to the museum of Yale University.

The first successful lithotrity operation in China was performed in 1856 by John G. Kerr, LL.D., a graduate of Jefferson Medical College of Philadelphia, using the lithotritor of Charrière. The patient was a male, age 28, resident in the district of Ko Ming. The patient complained of bladder trouble for a year. At two sittings, on the 10th and 15th of October, the stone was so crushed within the bladder that it all came away with the urine.

For his earlier cases of perineal section, usually lateral, Dr. Kerr employed the Liston scalpel and the common staff. In some cases he combined lithotomy with lithotrity. He first crushed the stone with the lithotrite, then introduced the staff and cut down to the membranous urethra (but not the prostate). A cannula or jointed dilator of such size as could be admitted into the neck of the bladder with safety was then introduced, and through this the fragments extracted with forceps.

The first lithotomy operation upon a female was performed in 1874, and the first lithotrity in 1883.

Many of the cases of perineal section healed by first intention in 10 days. In cases of suppurative cystitis the Reginald Harrison drainage tube was used.

One case of lithotrity required 14 sittings, over a period of three and a half months. Fever and cystitis were frequent complications.

In his earlier years Kerr reported that he considered lithotomy safer than lithotrity (1): "The Chinese object very much to the crushing process on account of the length of time required when the size of stone makes it necessary to repeat the operation. While lithotrity is more painful and dangerous in many cases than lithotomy, it is gratifying to be able, in cases where it is suitable, to afford relief without resorting to the use of the knife from which all turn with horror unless moved by the most urgent necessity. For aged cases lithotrity is much the safest operation but in some cases it is inadmissible and the only choice is between cutting with little chance of success or leaving the patient to his fate."

In 1869, in order to deal with large hard calculi, Kerr devised the plan of performing a lateral lithotomy, then seizing the stone with forceps firmly, and drilling through the center, or fracturing the stone with chisel and mallet,

[2] *Incidence of disease.* Canton is frequently visited with epidemics of bubonic plague, cholera, small-pox, influenza, and unnamed fevers. During the past 5 years the incidence of disease of cases treated at the Canton Hospital has been according to the following order of prevalence: tuberculosis, syphilis, beriberi, bonchitis, gastritis, leprosy, diseases of the nervous system, typhoid fever, malaria, cardiac diseases, rheumatism, nephritis, splenomegaly, influenza, pneumonia, dysentery, and cirrhosis of the liver.

In the surgical service the order has been: infections, wounds and injuries, venereal diseases neoplasms, tuberculosis, diseases of the rectum and anus, of the lymphatic system (chiefly tuberculous), genito-urinary, and digestive systems, bones, joints, congenital abnormalities, diseases of the circulatory and of the respiratory systems.

Nephrolithiasis, cholelithiasis, and appendicitis are rare. Goiters are comparatively rare in this part of China.

During the past 3 years, in 6,146 fæcal examinations in this hospital, ova of intestinal parasites were isolated in 1,869, that is, in 30 per cent of the cases. Seventy per cent were ascaris lumbricoides, 15 per cent trichocephalus dispar, 7 per cent clonorchis sinensis, 2 per cent ankylostomum duodenale, and less than 1 per cent amœba, balantidium coli, and fasciolopsis buski.

[1] Read before the Section on General Surgery at the Joint Conference of the China Medical Missionary Association and the National Medical Association, Peking, China, February, 1920.

Fig. 1. A group of vesical calculi removed from patients. The group measures 3 feet long by 1 foot wide by 1 foot high.

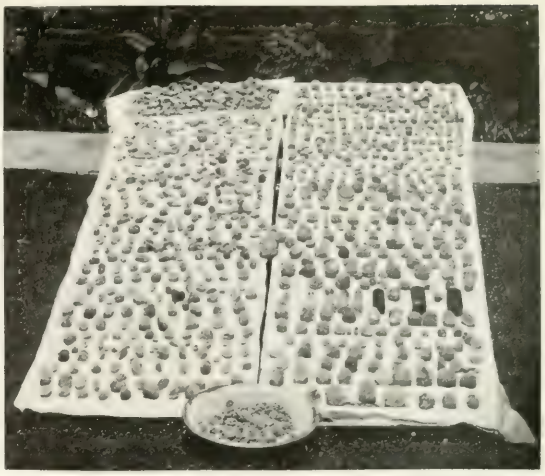

Fig. 2. Some urinary calculi removed from patients in the Canton Hospital. The boards are 8 feet long and 4 feet wide.

the remainder then being extracted. This took in some cases several hours. In a few cases suprapubic lithotomy was performed, usually in cases inoperable by any other method.

During the year 1879, Kerr secured a set of Bigelow's litholapaxy instruments, and used them for selected cases. He reported that some bladders will bear the long irritation of repeated crushings and evacuations, but there are others in which the slightest handling will light up intense inflammation. In 1886 Kerr devised a curved evacuator, with which attachment, after using the rubber bulb to inject the bladder, the fragments fall through the bulb into the glass receiver below, and all complicated apparatus is dispensed with.

In 1895 a complete set of instruments for litholapaxy, with a syringe for injecting cocaine, designed and perfected by Prof. W. S. Forbes, of Jefferson Medical College, and his son, was presented to the Canton Hospital under the presidency of John G. Kerr, by Professor Forbes and eleven other gentlemen, resident in Philadelphia.

In the year 1883, 64 operations were performed without a death, by lithotomy 34, litholapaxy 22, nephrolithotomy 1, extraction of urethral calculi 5, and of preputial 2.

One hundred patients suffering from calculus have been admitted to the hospital within a year. Hæmorrhage, immediate and secondary (checked by tamponing the rectum), peritonitis and pelvic abscess, exclusive of pre-existing disease, were the most frequent causes of death.

The hospital records show that during the period of 30 years prior to 1891, out of 1,236 cases of vesical calculus operated upon, 268 were by lithotrity or litholapaxy and 968 by perineal section. There were also 219 extra-vesical cases of calculus operated upon. The total weight of stone was 920 ounces. The largest stone weighed 8½ ounces. The longest known duration of symptoms was 25 years. The youngest patient was 2 years of age and the oldest 81. There were 10 females. Three hundred and forty-eight stones weighed over 1 ounce each. There were 36 recurrences, mostly from lithotrity. Sixty-one cases had multiple stones, one had 30 calculi. Two hundred and seventy cases were of more than 5 years' known duration of symptoms, 82 of over 10 years, and 14 of over 20 years' symptoms. The patients came from 32 districts of the province and a very few from other provinces, one traveling a distance of one thousand miles to the hospital, taking several months to reach his destination. The majority of the patients came from within a radius of 60 miles from Canton. The death rate for the lithotrity and litholapaxy operations was

9 per cent and for perineal section 8.6 per cent. Fifty-one per cent of the patients had pre-existing complications. The mortality excluding these, was, therefore, little more than 4 per cent.

The majority of the calculi were of uric acid and urates, then oxalates, phosphates and several of xanthin and calcium carbonate.

During periods of several years the operations were performed by Drs. Flemming Carrow and Joseph Clarke Thomson (2).

From 1891 to 1910 (inclusive) most of the operations were performed by John M. Swan, except during a period of several years when J. G. Kerr and P. J. Todd were associated in the surgical work. During this period 963 patients were operated upon by perineal section (usually lateral), 120 by litholapaxy and 50 by suprapubic cystotomy. Two hundred and thirty-eight urethral and preputial calculus cases were dealt with. The largest stone weighed 11½ ounces. The average weight of the calculi was 7½ drachms and the total weight 924 ounces. The death rate was 9.5 per cent. Fifty per cent of the cases which died had pre-existing diseases or complications. Excluding these, the causes of death were shock, hæmorrhage, peritonitis, uræmia, septicæmia, pneumonia, malaria, fever, exhaustion. The cases came to the hospital from 38 different districts of this and other provinces. The great majority were farmers and laborers. Thirty per cent were children under 10 years of age. Twenty-eight of the cases were females. Fifty-six had multiple calculi. Three hundred and fifty-one of the stones were of over 1 ounce weight. One hundred ninety-two were of over 5 years' duration, 60 of over 10 years, and 6 of over 20 years known duration of symptoms.

Swan preferred perineal lithotomy except in a few specially selected cases when he performed litholapaxy or suprapubic cystotomy. His reasons were (3): "First, a distinct tendency toward a higher mortality after litholapaxy than after lithotomy; second, the frequent recurrence of stone after lithotrity, and its very rare occurrence after lithotomy; third, the ease and quickness with which perineal lithotomy can be done. A careful study of statistics covering a period of 25 years prior to my taking up this line of work, and more particularly, my observations and experience for 10 years after coming to China, led me to the conclusion that frequent recurrence, subsequent cystitis, difficulty of suitable drainage and irrigation, the prolonged operation, and the delay of the patient in the hospital after lithotrity, justified the simpler, easier, and safer method of perineal section in the majority of cases. Perineal section requires from 3 or 4 to 10 minutes in time, and in children can often be completed under primary anæsthesia. Recovery is generally uneventful, the wound closing in from one to two weeks, unless the stone removed is unusually large. Fistula, sterility, stricture, or any subsequent complication is almost unknown."

The prevailing chemical constituents were sodium and ammonium urates and calcium phosphates.

One patient had four successful operations for vesical calculus; in 1874 by J. G. Kerr, in 1884, by Joseph C. Thomson, in 1889 by J. M. Swan, and again by Swan.

During the period of 9 years from 1911 to 1919, 585 cases of calculus of the urinary organs were operated upon. In 1914 and 1915, owing to the disturbed state of the province, the number of patients admitted with this condition was considerably below the average. There were 512 cases of vesical calculus, 53 urethral, 16 preputial, and 4 renal. Twenty-three were females. The patients were residents of 33 different localities. A few of the patients came from five other provinces. Thirty-three per cent came from the immediate neighborhood of Canton, but only several from Canton city. The oldest patient was 75 years of age, the youngest 2. The average age was 26½ years. Forty-nine per cent were under 20 years of age; 33 per cent from 20 to 50, and 17 per cent were over 50 years old.

The longest known duration of symptoms was 31 years, the average 3 years. Twenty per cent were of over 5 years' duration, and 5 per cent over 10 years'.

Thirty-eight per cent of the patients were children under 15 years of age, mostly of the farming and laboring class. Forty-six per

cent were farmers and laborers, 10 per cent students, and 7 per cent merchants.

The heaviest stone weighed 14 ounces. The average was 7 ounces. Twenty-four per cent of over 1 ounce weight. The total weight was 410 ounces. There were 25 cases of multiple calculi; one had 155 small vesical stones.

Seventy-one per cent of the calculi were of uric acid and urates (sodium, ammonium or potassium), and of these 13 per cent were coated heavily with phosphates, either calcium or triple. Sixteen per cent were chiefly phosphatic; 8 per cent were oxalates, usually of calcium; under 1 per cent of the cases were of combinations of urates, oxalates, and phosphates, and there was one of cystin.

Of the cases over 70 years of age, there were 4, all of whom were cured: 3 were farmers and 1 a merchant. The stated duration of disease was 2 and 3 years. The stones were small and were of urates and phosphates. No change of work, residence, diet, or habit had taken place.

Of the 512 cases of vesical calculus, 300 were operated upon by suprapubic cystotomy (58 per cent of the cases), 201 by perineal section (38 per cent), 2 per cent by vaginal cystotomy, litholapaxy and combined suprapubic and perineal cystotomy.

The operative mortality for the whole series of cases of urinary calculi was 8.7 per cent, for the vesical cases 9 per cent. There was no selection of cases. The greater proportion of cases suffer severely from pain, and the only relief that can be afforded is by operation. In over 98 per cent of the total number of cases intestinal parasite ova were isolated. Seventy-four per cent showed albumin in the urine; 32 per cent had alkaline urine; 24 per cent were of calculi of over 1 ounce in weight. Most of the deaths were in the first few cases of junior surgeons. Sixty per cent of the deaths were due to pre-existing disease or complications, or to postoperative disease or complications not related to the operation. Excluding these, the death rate for the vesical cases was 3.6 per cent, for the suprapubic cystotomy 3 per cent, for perineal section 4.9 per cent.

Of the cases that died, 22 per cent were under 15 years of age, 54 per cent between 15 and 50, and 24 per cent over 50 years old. The average age was 33 years. The average known duration of disease was 5 years. The chemical composition of the calculi was as follows: uric acid or urates 69 per cent, phosphates 13 per cent, urates and oxalates 8 per cent.

Fig. 3. A solid pile of stones (18 by 24 inches at the base) removed by operation from patients in the Canton Hospital.

The causes of death were: cardiac disease, cardiorenal disease, pyelonephritis, suppurative cystitis, malaria, peritonitis, pneumonia, influenza, extravasation of urine and sepsis, exhaustion, multiple complications, fever collapse, uræmia.

The following data have been collected from the records of more than 300 cases of vesical calculus operated upon during this period:

Symptoms. All cases showed marked urinary symptoms. Ninety per cent complained of dysuria. The pain was usually most severe at the end of micturition and referred to the urethra or glands, sometimes to the perineum, suprapubium, or back. In many cases the pain is constant and causes insomnia. In 30 per cent of cases the pain was aggravated upon movement. In 28 per cent there was bladder pain. A small rough stone is usually the most painful, although sometimes a smooth calculus causes intense pain. The bladder may become tolerant to a large stone, which may become adherent to the mucous membrane.

Hæmaturia was present in 70 per cent, usually at the end of micturition, in drops. Body movements and exertion would bring it on.

Forty-one per cent complained of frequency and urgency of micturition, sometimes 30 times during the day and up to 7 times at night in severe cases.

Thirty per cent had pus in the urine. Frequently the urine was foul.

In 23 per cent the stream was interrupted; the same percentage complained of difficulty in urination. Twenty per cent had strangury. Sixteen per cent passed but scanty urine. Seventeen per cent had passed sand or gravel. Twelve per cent were admitted with complete retention of from 2 to 10 days, a number with extravasation of urine, and occasionally sloughing of the tissues. Four per cent suffered from eneuresis. Two per cent had fever. The same percentage required circumcision for phimosis, mostly congenital, a few acquired.

In 80 per cent of cases there were rectal symptoms. Of these 40 per cent had prolapse of the rectum of varying degrees, accompanying the act of micturition. Twenty per cent complained of pain and difficulty in defæcation. In 18 per cent defæcation accompanied micturition. The same percentage were inclined to constipation.

In females the menses may or may not be disturbed.

Some cases complained of a feeling of pressure, of weight, of feeling a foreign body in the bladder upon moving.

Fæcal examinations. In 98 per cent of cases, ova of intestinal parasites were isolated, in this proportion: ascaris lumbricoides, 57 per cent; tricocephalus trichiuris, 20 per cent; ankylostomum duodenale, 10 per cent; multiple, 6 per cent (in one case 4 different varieties of ova were found); amœbæ, 2 per cent; clonorchis senensis, 3 per cent; oxyuris vermicularis, 1 per cent; tape worms, 1 per cent. One patient passed 93 ascaris worms.

Urinalyses. In 64 per cent the urine was acid; in 32 per cent, alkaline; and in 3 per cent neutral, upon admission to hospital. There was albumin in 74 per cent, sediment in 58 per cent, blood in 29 per cent, and pus in 32 per cent. In 20 per cent, the specific gravity of the urine was from 1,000 to 1,009, in 49 per cent from 1,010 to 1,019 and in 31 per cent from 1,020 to 1,029.

Hæmoglobin. In 5 per cent of the cases, the hæmoglobin was 40 to 49 per cent; 50 to 59 per cent in 9 per cent; 60 to 69 per cent in 14 per cent; 70 to to 79 per cent in 40 per cent; 80 to 89 per cent in 4 per cent.

Blood pressure. In a comparatively small number of cases the systolic, under 100 milligrams mercury, 38 per cent; 100 to 120 milligrams mercury in 47 per cent of cases; above 120 milligrams mercury, 13 per cent.

Leucocyte count. In a relatively small series of cases, 5 to 7 000, 18 per cent; 7 to 10,000, 59 per cent; 12 to 14 000, 22 per cent.

Erythrocyte count. Number of cases too small for use.

Renal function tests. Series too small to be of interest yet.

Postoperative temperatures. Highest or lowest temperature after operation, centigrade scale—36° less than 1 per cent of cases; 36.8 to 37°, 4 per cent; 37 to 37.8°, 26 per cent; 38 to 38.8°, 41 per cent; 39 to 39.8°, 23 per cent; 40 to 40.8°, 7 per cent; 41°, less than 1 per cent.

In 61 per cent of the cases, the wounds healed by first intention. The average duration of time in the hospital after operation was 22 days. In many cases patients remain in the hospital for a few days after the wounds are completely healed, awaiting friends from the country to accompany them home.

Three hundred and forty-eight cases in this series were operated upon by myself (170 by suprapubic cystotomy, 166 by perineal section and 12 by other methods). The other operators included J. M. Swan, J. M. Wright, J. Kirk, W. G. Reynolds, and K. M. Chau, to whom thanks are due for the use of their records.

During the past year, 1919, 71 patients were operated upon for vesical calculus, and 5 for urethral (6.6 per cent of major operations in the department of general surgery); 55 per cent were under 20 years of age, 27 per cent from 20 to 50, and 17 per cent over 50 years of age. The average age was 23½ years. The youngest was 3, the oldest 75. Sixty-two per cent were farmers and laborers, 11 per cent students, 11 per cent merchants and 15 per cent of miscellaneous occupations requiring manual labor. Five per cent were females. The longest known duration of disease was 16 years, the average 3½ years. Seven cases had multiple calculi, usually 2 or 3, but one had 155 stones (vesical). The heaviest stone weighed 185 grams. Ninety-two per cent were operated upon by suprapubic cystotomy. There were 4 deaths, giving a mortality of just over 5 per cent. The deaths were due to pre-existing complications. Two cases gave a history of gonorrhœa and entered the hospital with complete retention and extravasation of urine, subsequent to stricture of the urethra. One had pyelonephritis and ankolostomiasis. One, 65 years of age, with high blood pressure, died after a subsequent prostatectomy. He was admitted to the hospital with complete retention, had a greatly hypertrophied prostate, 155 vesical calculi, inguinal hernia, and double hydrocele. Novocaine anæsthesia was used for 3 of these cases.

Preparation of cases. Over 60 per cent of our cases have suffered for years, are weak, have lost

weight, suffer from insomnia and are anæmic from intestinal parasites. The great majority are poor and cannot afford to remain for any length of time in the hospital except as pure charity cases. In order to obtain the best possible result careful preparation is necessary, unless the case be an emergency one, with retention, great pain or prostration.

Diagnosis has been made with the metal searcher and if necessary, the X-rays. In the case of children unless there are contra-indications a general anæsthetic is administered, and if a stone is found the operation is proceeded with.

If ova of intestinal parasites are isolated (present in 98 per cent of our cases) the proper anthelmintic is administered. For cystitis, urotropin is given and the bladder irrigated with a weak solution of potassium permanganate. Before operation bicarbonate of soda is administered for 3 days. Usually no purgative is given, as the majority of cases have been well cleared out in expelling the intestinal parasites.

In routine cases, in fair condition, chloroform anæsthesia is most suitable in this hot and humid climate. In cases of insufficiency of the heart or kidneys or for other serious organic disease, or exhaustion, novocaine local anæsthesia is employed.

Immediately prior to the operation, the bladder is thoroughly irrigated through a double channel catheter with potassium permanganate solution, 1:4000, the operative field is then swabbed with iodine, the anæsthetic administered, and the bladder filled with air or warm solution, usually the latter. The Trendelenburg position is useful.

In a *suprapubic cystotomy* an incision is then made extending from the pubic bone upward for three inches, through the skin, fascia, and aponeurosis. The recti and pyramidali are separated to the pubic bone and retracted laterally. The reflection of peritoneum from the bladder is carefully retracted upward. In a few cases the peritoneum is found to be adherent to the pubic bone and must be separated and repaired if lacerated. In one case, a female, the bladder was almost completely covered with peritoneum, so that it was impossible to open the bladder without causing peritonitis. Because of the size of the stone (185 grams) and the fact that it was adherent to the bladder mucosa, it was necessary to perform a vaginal cystotomy. After fracturing the stone with a chisel and mallet, the fragments were with great difficulty extracted. The calculus was an agglomeration of multiple smaller stones.

The bladder wall is then seized with Allis forceps on both sides of the site of the proposed incision, or traction sutures are introduced. If the stone is very large (its size and consistency is determined before operation), a transverse incision obviates the necessity of suturing the bladder deep down in the pelvis. The bladder incision should be as small as will admit of the extraction of the stone, grasped by the forceps by the smallest diameter, but sufficiently large to avoid the necessity of lacerating the bladder. After extracting the calculus, careful search should be made for more stones, which may be encysted or sacculated, and the condition of the prostate ascertained. In cases of cystitis, the bladder must, of course, be drained. A thickened mucosa from which there is considerable hæmorrhage, may require suturing to the rubber drainage tube.

In over 60 per cent of cases, the bladder may be safely closed with the expectation of securing primary union. A continuous suture of chromic catgut is introduced through muscularis and submucosa, but not through the mucous membrane. Before tying this, blood clots are washed out of the bladder by irrigation through the urethra, and an inlying rubber catheter inserted. A second layer of sutures of chromic gut are inserted, preferably by the continuous Lembert method (Cushing).

A prevesical drain for 48 hours is advisable. The abdominal wall is then closed, using catgut for the aponeurosis, and through-and-through silkworm gut sutures. An interrupted suture of silkworm gut may be introduced, to be tied after the removal of the drain.

Keep close watch of the temperature, and of the suprapubium for a few days. Should there be pain, tenderness, or signs of inflammation, remove a stitch and drain. Fomentation and irrigation are helpful.

The catheter may be left in for 3 or 4 days but should be changed. If it is necessary to use a small bore catheter, watch for blocking. Continuous siphonage through the catheter, using an irrigator and Y tube is very useful (suction).

Should it be necessary to drain the bladder, abundant dressings are necessary for absorption, or preferably use suction siphonage.

ILLUSTRATIVE CASES

Case 1913-5, age 2, resident of Kolu district, duration of symptoms 1 year, operated upon by perineal section. The calculus was composed of urates and phosphates, weighed 5 grains, was 2 by 1 inch diameter. Cured.

Case 1913-49, age 75, from Tung Koon district, a farmer, 2 years duration of symptoms, operated upon by perineal lithotomy. The calculus was composed of urates, measured 1¼ by 1½ inches, and weighed 4½ drachms. Recovered.

Case 1915-5, Male, age 39, from Tsing Uen, a farmer, 31 years' duration of symptoms. The calculus was removed by suprapubic lithotomy, was composed of urates, measured 6.5 by 5 by 5 centimeters and weighed 89.5 grams. The patient died a week after operation from uræmia.

Case 1912-23, male, age 20, from Fa Uen district, a laborer; 15 years' duration of symptoms. The calculus was removed by suprapubic cystotomy, was composed of urates, measured 2 by 1¼ inches, and weighed 1 ounce, 1 drachm. Recovered.

Case 1913-25, male, age 53, of San Ning, a laborer; 1¼ years' duration of symptoms (patient's report). Through a suprapubic cystostomy; the calculus composed of urates and phosphates, frag-

ments was removed. It weighed 14 ounces. The patient recovered. The stone was adherent to the bladder mucosa. Suppurative cystitis and abscess.

Case 1918-29, male, age 24, from San Ning, a farmer; 17 years' duration of symptoms. Suprapubic lithotomy. Recovered.

Case 1914-28, male, age 24, of P'un Ue district, a farmer; 20 years' duration of symptoms. The stone composed of calcium oxalate and urates, measured 9.2 by 7 by 7 centimeters, weighed 298 grams, was removed by suprapubic cystotomy. Recovered.

Case 1916-1380, a male, age 65, farmer. He had had gonorrhœa 10 years previous, with complete retention for 2 days, stricture, hypertrophied prostate, hæmorrhoids, double complete inguinal hernia, 8 small vesical calculi. A suprapubic lithotomy and prostatectomy were done and the patient died a few days later.

Case 1914-217, a male, age 9 (Chinese reckoning, plus 1 year as compared with western), from Tsing Uen, a farmer boy; 5 years' duration of symptoms, hæmaturia, dysuria, sediment in urine, ova of ascaris in fæces, entered the hospital April 18. On April 21, by perineal section 2 calculi, 1 dumbell-shaped of uric acid and sodium urates were removed. On May 6, 13 days after operation the patient was discharged cured with the wound completely healed. Highest temperature after operation was 37.4°.

Case No. 1919-448, a male, age 40, from the district of Sz Wui, a farmer; duration of symptoms given as 2 years, with dysuria, frequency, interrupted micturition, pain in bladder, hæmaturia (after walking); constipated, prolapse on mucous membrane of rectum; cough; urine, yellow, acid, specific gravity 1 012; albumin, sediment; fæces, ova of ankylostomum duodenale; fairly well nourished; circulatory and respiratory systems, negative; blood pressure 105-65. The patient was admitted March 24; operated upon by suprapubic cystotomy and lithotomy March 27; discharged cured April 10. The wound healed by first intention with no leakage. Highest temperature 37.4°, the day after operation.

Case No. 1919-2067, a male, age 12, from the district of Hoi Ping; a school boy; admitted to the public ward November 3. Duration of symptoms stated to be 3 years. First symptom was hæmaturia, then sharp cutting pains along the urethra and glands, particularly at the end of micturition, sudden interruption of the stream with pain, some fever at times, passed one small stone, complains of urine being dirty and foul. When urination is stopped, he had great pain which caused him to press upon his perineum with his heel. He found he could pass his urine best when lying upon his back. He was constipated at times, at other times defæcation and micturition took place simultaneously, and there was prolapse of the rectum. The boy studied in the mornings, and was in the fields in the afternoons. His symptoms commenced in the summer and were worse in the following spring and summer. He had never noticed pain in the back or loins. He was fond of swimming in the summer. Examination of the urine before operation showed color yellow, reaction, acid (10 per cent), sediment, scanty amounts albumin. In the fæces, were ova of ascaris lumbricoides, leucocyte count 8 700. Blood pressure 110-60. Hæmoglobin, 70 per cent. Medication expelled 7 ascaris worms. On November 6, a suprapubic cystotomy was done and bladder sutured. A calcium oxalate calculus was removed, measuring 2.5 by 2.5 by 2 centimeters in diameter, weighing 11 grams. Postoperative urinalysis showed urine yellow, acid, specific gravity 1,004, slight albumin and sediment. The fæces, were negative. On fifth day, the temperature 38°; seventh day, 40°; ninth day, 38° (malaria). Quinine brought the temperature down to normal. The catheter was removed on the third day. The wound was soundly healed on the ninth day. The patient was discharged cured on the twelfth day after operation, having been in the hospital for 15 days.

Case 1919-1919, a male, had a piece of straw introduced into his bladder *per urethram* by a Chinese quack 3 months previously. The straw, 19 centimeters in length was extracted from the urethra encrusted with uric acid and urate salts, 1 centimeter in diameter, weight 3 grams.

Case No. 1919-111, a male, age 80, with a urethral calculus, had had a partial amputation of the penis for malignancy 7 years previous.

Case No. 1917-1016, a male, age 59, of Shun Tak district, was admitted to the hospital on September 9, complaining of painful micturition, which commenced 1 year ago, which is aggravated by walking and which also causes hæmaturia. There was frequency of urination. The patient was well nourished, the heart and lungs were negative. Blood pressure 128-76. Urinalysis showed specific gravity 1,010, acid reaction (30 per cent), albumin, sediment, blood cells. Fæces contained ova of ankylostomum duodenale and tricocephalus dispar, amœbæ of dysentery, and tænia solium. Treatment, vermifuges, urotropin and soda bicarbonate, bladder irrigations. September 11 operation, suprapubic cystotomy. A calculus was extracted, the bladder sutured with chromic gut, a prevesical drain inserted for 48 hours, the abdominal wall wound closed with through and through sutures of silkworm gut, inlying catheter left *in situ* for 3 days. The wound healed by first intention, and the patient was discharged cured on September 21, the tenth day after operation. Highest postoperative temperature 37.4°.

Case 1918-1912, a male, age 8, of P un Ue district, was admitted on December 7 with complaints of pain in the bladder, dysuria, and hæmaturia for the past 3 years. Urine was yellow, acid, 1,010 (no albumin or glucose). Fæces contained ova of ascaris lumbricoides. Suprapubic cystotomy and lithotomy December 10. The bladder was sutured. The wound healed by primary union. Highest tem-

perature after operation, 38°, third and fourth days. The patient was discharged on the eleventh day after operation, having been in the hospital for 14 days.

CASE No. 1918-1927, male, age 5 (Chinese reckoning, 4 western), of P'un Ue district, the son of a fisherman, was admitted on December 12, complaining of painful micturition, hæmaturia, pain in bladder when walking, rectal tenesmus, and prolapse of the rectal mucosa with defæcation. The patient was well nourished, but suffered very great pain. Suprapubic cystotomy December 14. The wound healed by first intention. Highest temperature after operation, 37.4° on the second day. Discharged cured on the twelfth day after operation, December 26, having been in the hospital for 14 days.

CASE No. 1919-1961, male, age 9, the son of a farmer residing in the district of Ko Ming, was admitted on October 17 having had symptoms during the previous 8 years, of dysuria, sudden interruption of urination, with pain, of having passed sand, frequency and urgency of micturition, and partial prolapse of the rectum with defæcation. Urinalysis yellow, alkaline, specific gravity 1.010, albumin. Fæces showed ova of ascaris, passed 1 worm. Suprapubic cystotomy October 20. The bladder was sutured, and prevesical drain and retention catheter inserted. Highest postoperative temperature, 37.4° for 1 day. Primary union of wound. The patient was discharged on the fourteenth day after operation December 31, having been in the hospital for 17 days. The calculus consisted of urates and phosphates, was 3.5 by 3 by 2 centimeters in diameter, and weighed 18 grams.

CASE No. 1919-887, male, age 11, the son of a farmer from the district of San Wui, was admitted to the hospital on May 28 with complaints of dysuria, sudden and at times complete stoppage of micturition and hæmaturia, from which he had suffered for over a year. The patient weighed 40 pounds. A stone was felt and heard with the searcher. The urine was yellow, acid, 1,020, a little albumin was present, and there was sediment. Fæces showed ova of ascaris. Suprapubic cystotomy and lithotomy June 7. The bladder was sutured with chromic gut and a prevesical drain was inserted for 48 hours, an inlying catheter for 4 days. The wound healed by first intention and the patient was discharged cured June 18, 11 days after operation, having been in the hospital for 21 days—10 days before and 11 days after operation. The highest temperature was 37.6° immediately after the operation, descending to normal on the fourth day, by lysis.

CASE No. 1919-1528, a male, age 42, a farmer, from the district of Wei Chau, was admitted to the hospital on August 17, with complaint of symptoms which he stated had lasted for 1½ years, of pain during and chiefly at the end of micturition, pain in the bladder when he walked, and dirty urine; and with some prolapse of the rectal mucosa with defæcation. The urine was yellow, acid, specific gravity 1,020, sediment. Fæces contained ova of ascaris. Leucocyte count 12,300. Hæmoglobin 68 per cent. Erythrocyte count 4,890,000. Operation, August 23 after 6 days of urotropin, bladder irrigations with weak potassium permanganate solution, soda bicarbonate, and the worms expelled by the administration of santonin and calomel. Suprapubic cystotomy was done under chloroform anæsthesia by J. O. Thomson and K. M. Chau, W. M. Foo, anæsthetist. The bladder was closed with 2 layers of continuous chromic gut sutures with through-and-through prevesical drain. We inserted an inlying catheter and closed the abdominal wall with sutures of silkworm gut. Primary union of the wound. Highest postoperative temperature 38°, first and sixth days after operation. Postoperative urinalysis; reaction, acid, specific gravity 1,020, no albumin or sediment. The patient was discharged cured on the twelfth day after operation on September 5, having been in the hospital for 6 days before and 13 days after operation.

COMPLETE STATISTICS

Three thousand, four hundred and ninety-two operations for calculus of the urinary organs have been performed in the Canton Hospital, by far the greater number since 1870.

Two thousand, nine hundred and sixty-two were vesical (bladder), 409 urethral, 116 preputial, and 5 renal. Several cases had both vesical and urethral calculi, and 4 cases in addition had calculus in the scrotum.

Two per cent of the cases were females. Seventy-one per cent were of the laboring class (50 per cent farmers), 16 per cent merchants and 4 per cent students, and the balance children under 10 years of age, also mainly of the farming class.

The patients were residents of 38 different districts. Ninety per cent were from within a radius of 60 miles from Canton, within or upon the borders of the delta. Thirty-two per cent came from the 2 districts nearest Canton. Very few were residents of Canton city.

Forty-three per cent were under 20 years of age, 41 per cent from 20 to 50, and 14 per cent over 50 years old. Twenty-five per cent were under 10 years of age, 18 per cent from 11 to 20, 14 per cent from 21 to 30, 15 per cent from 31 to 40, 11 per cent from 41 to 50, 9 per cent from 51 to 60, 4 per cent from 61 to 70, 0.8 per cent from 71 to 80 and 1 case 81 years of age. The youngest was 2 years old. There were 3 of this age that recovered. The oldest was

81 years. There were 3 of 80 years. The oldest that recovered was 80 years old.

The longest known duration of symptoms in the vesical cases was 31 years, in the urethral, 50 years. The average duration (vesical) was 3½ years. Twenty per cent of the cases were of more than 5 years' duration; of these 25 per cent were of over 10 years and 4 per cent of more than 20 years' duration of symptoms.

One hundred and forty cases had multiple stones (vesical), 1 had 155 stones, other cases 30, 23, 20, 14, 10, 9, 8, 7, 4 (15 cases), 125 cases had 2 or 3 calculi.

The heaviest stone weighed 14 ounces, the average weight was 7½ drachms, and the total weight of the vesical calculi was 2,254 ounces.

Chemical composition. Seventy-eight per cent of uric acid and urates, 5 per cent of phosphates, 4 per cent of oxalates, 1 per cent of oxalates and urates. There were 3 calculi of calcium carbonate, 2 of xanthin and 2 of cystin. The urates were of sodium, ammonium, and potassium, the phosphates chiefly of calcium, some triple, the oxalates usually of calcium, some of sodium. One stone was of calcium oxalate coated with calcium carbonate.

Patients with uric acid calculi were residents of 25 different districts throughout the province, urates from 21, oxalates from 21, calcium phosphates from 13, triple phosphates from 11, calcium carbonates from 4, xanthin from 2, and cystin from 2 districts.

The multiple stones were of uric acid, urates, oxalates, and phosphates.

Of the cases with duration of symptoms of over 10 years, 81 per cent had calculi of uric acid or urates, 9 per cent of phosphates, 5 per cent of oxalates, 3 per cent of oxalates and urates.

No change of residence, work, habit, or diet could be elicited to account for the chemical change from oxalates to urates or vice versa.

One patient possessed 124 preputial calculi. Another had 291 stones in a sac communicating with the urethra, of 20 years' duration.

Some stones were rough, particularly the oxalates (mulberry), others smooth. They may be ovoid (usually), round, triangular, dumbell, jointed (ball and socket), or irregular in shape. If multiple they are usually facetted. The rough stones are usually covered with blood.

Oxalates. One hundred and twenty cases were from 21 different districts. The oldest was 64 years of age, the youngest 3. The average age was 22 years. One to 15 years of age, 45 per cent; 16 to 50, 45 per cent; over 50, 5 per cent. The duration of the disease was from 6 months to 20 years, average 5½ years. The average weight of the calculi was 7 drachms. The death rate from operation was 3.8 per cent. Seventy per cent were farmers, 20 per cent students, and 8 per cent merchants. The largest oxalate stone was 3¼ by 2¼ inches in diameter. There were a few cases of more than one stone, either 2 or 3. The calculi were of calcium or sodium, mainly the former. A few were combined with uric acid or urates, some coated with phosphates.

Operations. Vesical. One thousand, nine hundred and ninety cases, or 72 per cent, were operated upon by perineal section, either median or lateral; 384, or 14 per cent, by lithotrity or litholapaxy (since 1879, 330 cases or 12 per cent by litholapaxy with the Bigelow or Forbes instruments, with the same operative mortality as the whole series of lithotrities and litholapaxies); 350 cases, or 13 per cent, by suprapubic cystotomy, and less than 1 per cent of cases by vaginal cystotomy (3), suprapubic and perineal cystotomy (3), suprapubic and vaginal cystotomy (2), lithotrity and perineal section (2).

Some of the cases also required prostatectomy, urethrotomy for stricture, circumcision for phimosis, multiple incisions for extravasation of urine, cauterization and secondary suture for fistula.

The total mortality was 8.1 per cent. Fifty-one per cent of the cases that died suffered from pre-existing disease or complications or postoperative complications not related to the operation. Deducting these, the death rate would be 3.9 per cent.

The death rate for the suprapubic operations was 7.8 per cent. In the earlier years, however, this operation was only performed as a last resort. Excluding these cases and

the number that had pre-existing complications or concomitant diseases, the death mortality was 3 per cent.

The operative mortality in cases of perineal section was 7.9 per cent; uncomplicated, 3.8 per cent.

For the lithotrities and litholapaxies, it was 9 per cent, uncomplicated 4.4 per cent.

Twenty-five per cent of the cases that died were under 20 years of age; 47 per cent from 20 to 50; 28 per cent over 50 years old.

Of the suprapubics 28 per cent were under 20 years of age; 44 per cent from 20 to 50; 28 per cent over 50 years old.

Of the cases operated upon by perineal section that died, 28 per cent were under 20 years of age; 48 per cent from 20 to 50; 24 per cent over 50.

Of the deaths after the crushing operations 43 per cent were between 20 and 50 years old; 57 per cent over 50.

(In 34 per cent of the total number of cases operated upon, the calculus weighed over 1 ounce. In 20 per cent of the total cases [vesical] the duration of disease was of over 5 years' duration, the average being 3½ years.)

Litholapaxies. From 1879 to 1896, 226 cases were operated upon with the Bigelow instruments, and from 1897 to date, with the Forbes apparatus, 104 cases, making a total of 330 cases. The mortality was 9 per cent. The deaths were due to cystitis, uræmia, peritonitis, septicæmia, malaria, dysentery, collapse, recurrence. In a few cases the operation was discontinued, and occasionally some other type of operation performed. The largest stone crushed was 1 ounce in weight. Ninety-five per cent of the calculi consisted of uric acid or urates, frequently coated with phosphates. Half a dozen of the stones were composed of oxalates. The complete operation was usually performed at one sitting.

Complications which were the cause of death, in order of frequency: suppurative cystitis, pyelonephritis, multiple calculi, dysentery, postgonorrhœal stricture with extravasation of urine, cardiac disease, exhaustion, hæmorrhage, peritonitis, malaria, fever, uræmia, cariorenal disease, shock, anæmia, septicæmia, multiple complications, pericarditis, pyæmia, perineal abscess, tubercular peritonitis, pneumonia, influenza, apoplexy and paralysis, hypertrophied prostate.

As illustrations of multiple complications may be mentioned: a male, age 65, with high blood pressure (150 systolic), greatly hypertrophied prostate, complete retention, had 155 small vesical calculi of uric acid, weighing 24 grams, right-sided complete oblique inguinal hernia and double hydrocele; tubercular spine with kyphosis, cystitis, and pyelonephritis.

A male with postgonorrhœal stricture, complete retention, hypertrophied prostate, had 8 vesical calculi, inguinal hernia and hæmorrhoids.

A male, age 56, 16 years' duration, complete retention, postgonorrhœal stricture, pyelonephritis and suppurative cystitis, had 2 calculi. Cystitis and pyelitis, 20 years' duration, 10-ounce stone.

Complications due to pre-existing, concomitant and postoperative recrudescence of disease are legion:

General: Eye diseases, from trachoma to total blindness. Middle ear disease, tonsillitis, cleft palate and hare lip. Gonorrhœa and its sequelæ, syphilis and its sequelæ, chancroid bubo (the agricultural class are relatively free from venereal diseases, but they are quite common among city residents); icterus, dysentery, splenomegaly (malarial and Banti), beriberi, opium addicts, appendicitis, cardiac and renal disease, hernia, tuberculosis of peritoneum and of spine, pleurisy, pericarditis, osteomyelitis, tubercular kidney, orchitis, influenza, pneumonia, vesicovaginal fistula, hydrocele, phthisis, intestinal parasites. A case with 31 years' duration of symptoms brought to the hospital in 1917 was unconscious; bladder mucosa was gangrenous.

Local: Calculus adherent to mucosa of bladder, perineal abscess, fistula, multiple calculi, both urethral and vesical calculi, multiple calculi in a sac opening into the urethra, calculus in the scrotum, stone ulcerated through bladder wall into vagina, ulcerated through the suprapubium, double bladder.

One patient, a boy, had been gored in the perineum 12 years previously. There was a persistent sinus, and the stone was found between the bladder and rectum, having ulcerated through the bladder wall. Encysted calculus, complete retention, stricture, extravasation, sloughing tissues of suprapubium and scrotum, including testicle; recurrence, several cases (3 times at varying intervals of from 6 months to 12 years), phimosis, congenital and secondary to venereal disease, small meatus, hypertrophied prostate, vesicovaginal fistula, cystitis, pyelitis, pyelonephritis, hæmorrhoids, prolapse of rectal mucosa or of the rectum, lacerated rectum, hæmorrhage, œdema of prepuce, bed sores, eczema, skin diseases of all varieties, previous amputation of penis for cancer, umbilical hernia, gangrenous condition of mucosa.

One case had 4 varieties of intestinal parasites, namely amœba of dysentery, tape-worm, trichocephalus dispar, and ankylostomum duodenale.

The condition is not hereditary. The great majority of the calculi appear to be primarily vesical. Very few complain of renal colic, or have symptoms of obstructed ureter. In one case a small second calculus was found emerging from the ureter, however. Five cases of renal calculus have been treated.

CONCLUSIONS

In deciding upon the operation to be performed, it is necessary to take into consideration the general condition of the patient, the age and the condition of the urinary tract, also the size, consistency, and mobility of the stone.

For the general surgeon, with a comparatively small experience in stone work, cystotomy should undoubtedly be the operation of choice in most cases. It can be performed rapidly, and with safety. The whole operative field is visible. Peritonitis can be avoided by careful retraction of the peritoneal reflection and in the case of a large calculus by fracturing or crushing it prior to extraction. There is but little probability of recurrence. It is the operation of necessity with a large, hard stone or abnormality or disease of the urethra, prostate, or bladder. The operative mortality in 350 unselected cases was 7.8 per cent or, excluding the earlier cases in which it was the operation of last resort and the cases in which there was pre-existing or concomitant disease, 3 per cent.

Perineal section, median for small stones, and lateral for larger, can be performed most rapidly, gives excellent drainage for cystitis, and is the operation of choice for medium-sized stones impacted in the prostatic urethra. The dangers are hæmorrhage, laceration of the rectum and fistula; sterility and stricture are possibilities, but rarely seen. Before puberty the bladder is small and more of an abdominal organ, so that it is more difficult to find and retain it through the perineal route than through the suprapubic. Recurrences are rare. The mortality in 1,990 cases was 7.9 per cent, or in the uncomplicated cases, 3.8 per cent.

Litholapaxy is preferred by probably the majority of urologists. A large practice is necessary in order to acquire skill. It is indicated in adults, with a healthy bladder and normal prostate and urethra, for calculi of small or medium size and hardness (uric acid or urates). It is contra-indicated in large and hard or soft stones, encysted calculi, cystitits, abnormality or disease of the prostate or urethra. It requires time. Drainage may not be satisfactory, the bruising of the urethra may cause urinary fever, cystitis may follow, or the bladder may be ruptured. Recurrence is more frequent than in the other types of operation. The mortality in 384 cases of lithotrity and litholapaxy—(330 cases by litholapaxy) was 9 per cent — uncomplicated 4.4 per cent.

Personal preference, experience and skill, and selection of cases will account for favorable statistics in almost any variety of operation. In females a small calculus may be extracted *per urethram*, or crushed and evacuated. Primary union may be expected after suprapubic lithotomy if the bladder is closed. Vaginal cystotomy should only be performed as a last resort, because a possible resulting fistula may be difficult to cure.

Urethral stones if near the meatus should be extracted; if in the membranous or prostatic urethra should be pushed back into the bladder and dealt with as a vesical calculus. A stone impacted in the penile urethra which would lacerate the organ were it roughly dragged out, should be removed by urethrotomy. The bladder should always be sounded, cystoscoped, or X-rayed for possible vesical stones.

In healthy individuals, for any type of operation, the administration of a general anæsthetic secures complete relaxation, assuring safety and speed. For cases with cardiac or renal insufficiency or sepsis from extravasation of urine or other complications, local or spinal anæsthesia will serve.

Etiology. It seems probable that a number of factors may combine to cause calculus of the urinary organs. The following may be included among them, with respect to the primary calculi:

Eighty per cent of the cases were from the farming and laboring class, living for the most part in small villages throughout the delta region (ninety per cent). Forty-three per cent were under 20 years of age and 25 per cent under 10 years old. The disease may, however, develop at any age, from 2 to 80 years. The majority (98 per cent) were males. (Probably the short, relatively wide and dilatable female urethra allows the calculi to pass easily; furthermore the Chinese women do not readily allow examination. The women labor as long and as hard as the men, and under the same conditions.)

The greater number of the patients state that their symptoms commenced in the spring or summer. The weather is then hot and humid. The laboring classes are at work in the open, under a blazing sun, they perspire profusely, and the urine therefore becomes highly concentrated and acid. The loss of moisture is replaced by the drinking of tea made with unfiltered river or well water, boiled. Spring water is seldom used in the delta. The children usually attend school until they are 10, or possibly until they are 15 or 17 years old, but many spend most of the day in the open watching the cattle. They are cold in the winter and hot in the summer.

Intestinal parasites were found in 98 per cent of the cases admitted within the past few years. Diseases of the digestive tract and malarias are very prevalent. (Intestinal stasis and bilharziosis are not common).

As a rule two or three meals a day are eaten, at long intervals. Rice is the staple, two to four bowls being taken per meal. Vegetables, including bean curd, fish, and occasionally meat are eaten with the rice. Very little liquid is taken with the meals, which are eaten quickly. Since 78 per cent of the calculi are composed of uric acid and the urates of sodium and ammonium and potassium, it is unlikely that lime in water or food is relevant

In regard to the oxalates. it is stated that the ingestion of certain articles of food that contain vegetable acids leads at once to the deposition of large amounts of calcium oxalate in the urine. Fruit eating may be a factor. The exciting cause may be an excess of oxalates or deficient acid phosphate of soda to hold the oxalate in solution.

The exciting cause of primary calculus is considered to be the deposit of uric acid or the acid urates, caused by the presence of a large amount of uric acid in the urine (either exogenous, from the ingestion of large amounts of nitrogenous food, or endogenous, from metabolic processess) —high degree of acidity of the urine, and the presence of little salt and a small amount of pigment. Irritation of the urinary tract is thus caused, with infection, the secretion of mucus, and the detachment of necrotic tissue, with hæmorrhage which forms a nucleus upon which the salts are deposited in layers upon a structure of albumoid and colloid substances. A foreign body in the bladder is frequently found to form a nucleus. There may be more than one nucleus.

The secondary deposit of the phosphates of calcium or of ammonium and magnesium (triple) is obviously due to the cystitis and alkaline urine. It may be due to retention and residual urine from obstruction due to stricture, hypertrophied prostate, phimosis, or from atony of bladder.

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PLACENTA PRÆVIA

An Analysis of One Hundred Cases

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IN considering placenta prævia from any standpoint, the accoucher is immediately confronted with a very complex problem; complex, because of the diversity of factors that must be considered. The age of the patient must be noted, as well as her parity; the period of gestation and the type of prævia play an important rôle; the condition of the mother and baby when first seen, as well as the number of living children the mother already has; the amount of cervical dilatation; condition of the membranes; the presence or absence of labor, all must be correlated before any plan of treatment is instituted. It will be seen that in few obstetrical complications must one's judgment be as unfailing as in placenta prævia, especially since the complication may demand any obstetrical operation from simple rupture of the membranes to cæsarean section.

The analysis which follows, aims to take into consideration all of the above factors. Our analysis further aims to be of practical value in that it is entirely clinical in scope.

In Table III it will be noted that there were 17 primiparæ, 78 multiparæ, and 5 patients in whom the parity was not known. There were almost five times as many multiparæ as primiparæ.

There were 58 marginal prævias (10 in primiparæ, 47 in multiparæ): 25 of central type (6 in primiparæ, 16 in multiparæ); 12 lateral prævias (1 in primiparæ, 11 in multiparæ); and there were 5 of unknown type.

Twenty-five per cent of the cases then, were of the central type. From the table, we note that 33 per cent of all cases were at or near term, and 55 per cent were in the last month of gestation. It will be seen that bag and version were used in 23 cases, etc.

MATERNAL MORTALITY

In our series of 100 cases, there were 9 maternal deaths.

Case 1. VI-para at 8 months with a marginal placenta prævia. Treated by version. Causes of death in this case, on the eighth day, were tuberculosis and inanition; an unavoidable death.

TABLE I.—AGES

	Primiparæ	Multiparæ	Unknown	Total
Under 20	2			2
20-25	6	13	1	20
26-30	7	16	1	24
31-35		17		17
36-40	1	21	1	23
Over 40		5		5
Unknown	1	6	2	9
Total	17	78	5	100

TABLE II.—PERIOD OF GESTATION

	Primiparæ	Multiparæ	Unknown	Total
5-7 months	2	9	2	13
7-8 months	4	16	2	22
8-8½ months	3	18	1	22
8½-9 months	8	25		33
Unknown		10		10
Total	17	78	5	100

TABLE III

	Primiparæ				Multiparæ				Unknown				Totals
	M	C	L	U	M	C	L	U	M	C	L	U	
Bag and version	1	1			13	6	1	1					23
Cæsarean section	1	2				3							6
Normal delivery					4		2	1				1	8
Forceps					3		1						4
Version	1	1			5	4	4	1		1			17
Breech extraction	1				2		3		1			1	8
Manual dilatation and version			1		6	1				1			9
Bag	2				3								5
Bag and breech extraction	1				1	1							3
Pituitrin and normal delivery					1								1
Rupture of membranes—bag—pituitrin	1												1
Instrumental dilatation and version						1							1
Rupture of membranes and pituitrin	1												1
Packing and normal delivery					2								2
Hick's version	1	1			5					1			8
Manual dilatation and and breech extraction		1											1
Partial podalic version.					2								2
Totals	10	6	1		47	16	11	3	1	3		2	100

M—Marginal C—Central L—Lateral U—Unknown

Case 2. VIII-para at 7½ months with a central placenta prævia. The patient was exsanguinated when first seen and treated by manual dilatation and version. We believe that a case of this type should be treated by cæsarean section, performed as rapidly as possible, with through-and-through sutures of the abdominal wall to save time.

Case 3. II-para of unknown period of gestation and unknown type of prævia. Treated by de Ribes bag and version. The patient died 2 hours after delivery, from shock, bleeding, and exhaustion. We are of the opinion that the plan of treatment used in this case, in spite of the unfortunate outcome, is the mode of procedure generally to be advised.

Case 4. V-para of unknown period of gestation with central placenta prævia, the cervix admitting two fingers when the patient was first seen. Treated by de Ribes bag and version. Considering the type of prævia, the multiparity, and the amount of dilatation when first seen, we believe the patient was treated in the most conservative way.

Case 5. Primipara at term with a central placenta prævia, the cervix four fingers dilated when first seen. Treated by version. This treatment was conservative though cæsarean section should be considered in a case of this type.

Case 6. II-para of unknown period of gestation with a marginal placenta prævia. Treated by manual dilatation and version. This patient died of sepsis, a most unfortunate and unavoidable complication in any large series of obstetrical cases.

Case 7. Multipara at term with a central placenta prævia. Treated by de Ribes bag and version. Considering the parity of the patient the use of the bag followed by version, was the conservative plan of treatment. This woman bled to death by continued hæmorrhage from the placental site, which might have occurred even though cæsarean section had been the procedure chosen. At autopsy no cervical laceration or uterine rupture was found.

Case 8. III-para with a marginal placenta prævia who had a 6 months' abortion. Treated by manual dilatation and version. In our opinion the operation of manual dilatation and version is usually unwise and extremely dangerous. Our rule in a case of this type and at this period (6 months) is invariably the use of the modified de Ribes bag.

Case 9. VIII-para at term with a central placenta prævia. Treated by version. The case was unfavorable, in that she had bled profusely before admission to the hospital. Although a conservative podalic version was done, there being no further hæmorrhage during delivery, the patient died of continued bleeding from the placental site. A post-mortem revealed an intact cervix and uterus.

At this point we note the fact that of the 7 fatal cases, where the variety of prævia was known, 5 were of the central type.

The total mortality then was 9 per cent, of which 8 deaths were in multiparæ, making the mortality of all multiparæ 10 per cent. One primipara died, giving a mortality in all primiparæ of 5 per cent. Excluding the case in which the patient died of tuberculosis and inanition, the maternal mortality is 8 per cent.

FŒTAL MORTALITY IN PRIMIPARÆ

There were 17 cases of placenta prævia in primiparæ, with 10 still-births, 57.6 per cent.

Of this series three babies were dead when the patient was first seen, and seven were (presumably) alive. Of the three dead babies, one was a case of 6 months' abortion. In another case at term no life had been felt for 3 days antepartum, and no fœtal heart could be heard. In another patient, at 7 months, the cord was prolapsed and pulseless when the woman was first seen.

Of the 7 cases in which the babies were alive, 1 patient was at 7 months, 2 at 7½ months, and 4 were at term. The three premature babies would probably have been lost in any event, one being a case of prolapsed cord and transverse presentation.

Histories of the four term cases follow:

CASE 1. Patient entered the hospital with central placenta prævia, the cervix four fingers dilated. Version was the most conservative plan of treatment, but unfortunately the mother died also.

CASE 2. Primipara at term with central placenta prævia and one finger dilatation. Unquestionably patient should have been treated by cæsarean section instead of podalic version.

CASE 3. Lateral placenta prævia. Treated by manual dilatation and version.

CASE 4. Marginal placenta prævia. Treated by bag and version.

In the analysis of these 10 cases, we believe that the method of procedure was faulty in but one, which as we have already stated should have had cæsarean section.

Taking into consideration only those cases in which the patient had proceeded beyond 7½ months, and where the babies were alive, there were 4 deaths, or 23.5 per cent.

FŒTAL MORTALITY IN MULTIPARÆ

There were 78 cases of placenta prævia in multiparæ with 53 fœtal deaths, 68 per cent.

Of this series, 21 were pregnant 7 months or less, and 4 were 7½ months pregnant. Three fœtus were macerated (2 at term and 1 of unknown period) and in addition to these, 2 babies at term were dead when the patient was first seen, making a total of 30 patients, in whom the babies were dead or were practically certain to be lost in any event.

Taking into consideration, however, only those cases in which the patient had proceeded in her pregnancy beyond 7½ months, there were still 23 deaths, or 29 per cent, a large mortality. Of these 23 fœtal deaths, we feel that in 3 cases of central placenta prævia at term cæsarean section might have been chosen. This operation would have saved all of the babies and possibly all of the mothers, one having died after version. While we do not advocate cæsarean section as a routine procedure in cases of placenta prævia in multiparæ at or about term, we believe that the patient should have the opportunity of electing the procedure, should she be most desirous of obtaining a living child, with slight additional risk to herself.

FŒTAL MORTALITY IN UNKNOWN PARITY

There were 5 cases of placenta prævia in women of unknown parity. Of this series there were 3 deaths, 60 per cent; 2 were at 7 months, both central placenta prævia; 1 a 6 months' abortion.

To summarize: in 17 primiparæ there were 10 deaths, 57.6 per cent; in 78 multiparæ there were 53 deaths, 68 per cent; in 5 cases of unknown parity there were 3 deaths, 60 per cent, giving an average in all of 66 per cent.

Deducting 39 cases in which the fœtus was dead or where fœtal death would probably have occurred in any event, we have a corrected fœtal mortality of 27 per cent.

When one considers that the fœtal mortality in breech extraction under ordinary circumstances during the last month of pregnancy is in the neighborhood of 15 to 20 per cent, the number of fœtal deaths in placenta prævia in our series of 100 cases (27 per cent), the vast majority of which were extracted by version, is surprisingly low.

TREATMENT

The treatment of placenta prævia must depend to a considerable extent upon the following conditions: age, parity, period of gestation, type of prævia, amount of cervical dilatation, condition of the patient, condition of the infant, number of living children, and finally the surroundings of the patient and surgical experience of the operator.

TABLE IV.—FŒTAL MORTALITY

	Primiparæ 10	Multiparæ 53	Unknown 3	Total
PERIOD OF GESTATION				
6 months abortion	1	9	1	11
6½ to 7 months	[illegible]	10	[illegible]	10
7 to 8 months	[illegible]	11		11
8 to 8½ months		2		2
Term	5	14		19
Unknown		1		1
TYPE OF PRÆVIA				
Central	3	10	2	15
Marginal	5	27		32
Lateral	1	5		6
Unknown		2		2
6 months abortion	1	9	1	11
OPERATION				
Bag and version	1	12		13
Breech extraction	1	3		4
Hick's version		3	1	4
Version	3	7	1	11
Normal delivery		5		5
Partial podalic version		2		2
Cæsarean section		1		1
Forceps		2		2
Packing and breech extraction		1		1
Manual dilatation and version	1	2		3
Instrumental dilatation and version		1		1
Bag	2	3		5
Bag and breech extraction		1		1
Pituitrin and normal delivery		1		1
Manual dilatation and breech extraction	1			1
Unknown (6 months aborton)	1	9	1	11
Transverse presentaton	1	2		3
Prolapse of cord	2	4		6
Antepartum death	2	6		8

Version would be the preferable plan of procedure in the large majority of cases of primiparæ and multiparæ with the cervix sufficiently dilated to admit the hand. Extraction of the child should be very gradual, except in those cases in which the cervix is fully dilated or nearly so.

The introduction of the de Ribes bag without rupture of the membranes is generally indicated in any case with a small amount of dilatation.

The forceps operation would be chosen only in cases of lateral placenta prævia, with practically full dilatation, the vertex presenting in the pelvis.

Rupture of the membranes is indicated only in patients with marginal or lateral placenta prævia, where the bleeding is slight, and where the cervix is already well dilated.

Packing is a temporary measure in an emergency until other obstetrical methods can be used.

Pituitrin in small doses of 2 to 3 minims is a valuable therapeutic measure in cases where uterine inertia is present.

Manual dilatation in placenta prævia is, in our opinion, a plan of treatment very likely to result in laceration of the cervix, and as a rule it is to be condemned as dangerous.

Cæsarean section has a limited but well defined place in the treatment of placenta prævia. In all primiparæ, at or near term, with central placenta prævia with but slight dilatation of the cervix, and the infant in good condition, cæsarean section offers the best result for mother and child, provided the operation can be performed under favorable circumstances by a competent surgeon.

This holds true also in a certain number of multiparæ where the patient elects to take the slight additional risk in order to have a living child. Again, let us consider the case of a multipara in the last 2 months of pregnancy, with a cervical dilatation of three fingers, who has already bled a large amount, and who is in very poor condition. Five of our nine fatal cases were patients of this type, and the question naturally arises: Would not cæsarean section have been a better plan of procedure? We have not performed cæsarean section in this type of cases, but we are of the opinion that under the best surroundings, a very rapid cæsarean with through-and-through sutures of the abdominal wound to save time might give better results.

The operation requires less time than version and extraction and is attended as a rule with small blood loss, and judging from a limited experience in cæsarean section for profuse bleeding in cases of accidental hæmorrhage, we believe that the cæsarean might be the operation of choice.

Following any mode of delivery, we believe that the uterus and vagina should be firmly tamponed with iodoform gauze, in order to limit as far as possible, continued bleeding.

PAPILLARY ADENOCYSTOMA OF THE OVARY OF THE PSAMMOCARCINOMA TYPE

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THE following case is reported as it presents features of remarkable interest both from the clinical and from the pathological point of view. Not only was the type of the new-growth unusual, but equally remarkable was the fact that during the whole course of the disease a total amount of 600,000 cubic centimeters of fluid, in 882 tappings, was withdrawn from the patient.

A perusal of the literature fails to reveal much in regard to the occurrence of this type of tumor in other parts of the body than the brain or meninges. In Ziegler's *Pathology* we find: "*Psammonata*, or sand tumors, are sarcomata or fibrosarcomata of the dura, inner meninges, or pineal gland, which contain concretions of lime salts in greater or less abundance. Some of these concretions are similar in structure to normal brain-sand, the basis of their formation being concentric layers of cells which have undergone hyaline degeneration. Occasionally the chalky spherules lie inside of the individual cells which have later become calcified. Others are more of the nature of spicules and arise from the deposit of lime salts in connective tissue or blood-vessels which have undergone hyaline degeneration." Ewing, in *Neoplastic Diseases*, page 296, states: "Types of endothelioma, 4, perivascular: The cells surround definite vascular paths usually in concentric fashion, as in the dura mater. Psammoma or sand tumor, applies to this growth when the units are calcified." Endothelial psammona of the skin is described by Winkler. "This rare tumor occurs in the form of multiple hard nodules in the cutis or subcutis which follow the course of the nerves and may be traced down to the periosteum. They are probably derived from the endothelium of nerve sheaths and traces of nerve-fibers may persist. They belong in the group of psammoma of nerve trunks. They consist of concentric masses of endothelial cells which are often calcified."

According to Winkler certain cases of calcified endothelioma of the skin (Perthes, Linser, Volkmann) have a similar origin. Psammoma of deeper nerve trunks is more frequent." And, again, referring to psammoma of the spinal meninges, page 423: "Psammoma arises from the spinal dura or arachnoid and usually produces a single firm, well encapsulated growth compressing the cord. Its progress is slow and several years are commonly required to reach rather limited dimensions which seldom exceed 2 by 4 centimeters. Pressure on the cord begins early, motor or sensory symptoms are prominent and extensive secondary degenerations are commonly established. In Stendeuer's case the cord was completely severed in the course of two years' growth. The tumors usually lie on the dorsal and lateral aspects of the cord, and chiefly in the lower half. The structure presents either a cellular or vascular form of sarcoma or a less cellular sclerosed tumor with much calcification. In the cellular forms there are many small canals surrounded by concentric layers of spindle or polygonal cells. Calcification of the walls of these small vessels may appear early when the tumors are cellular, yielding the "sarcome angiolithique" of Cornil and Ranvier. Very cellular forms of this tumor differ from the common spindle-cell sarcoma, chiefly in the presence of the calcific vessels. In late forms the growth may be largely composed of calcific granules and hyaline tissue."

As ordinarily thought of, the psammomata are tumors, often multiple, or pediculated, of a fibrosarcomatous or endotheliomatous type, which have undergone calcification, the lime being deposited in variously shaped calcareous masses similar in appearance to the so-called brain-sand. These arise usually from the membrane of the brain or cord, sometimes in the pineal gland, often developing in the choroid plexus. Most often they are in connection with the pia mater or under

the surface of the velum, and in the neighborhood of the transverse fissure, the summit of which is occupied by the pineal gland. The occurrence of this type of growth in other parts of the body is extremely rare, but it does occur. In Mallory, *Principles of Pathological Histology*, page 395, we find: "While these two forms of adenocystoma, and especially the papillary type, are not infrequently malignant, and, therefore, to be classed as carcinoma, that term is usually reserved for malignant epithelial tumors of the ovary which grow in the solid form, that is, in which cysts are not present. The cells may grow in the form of glands, or they may be massed together. The stroma is often excessively abundant. Occasionally multiple concretions appear and become calcified (psammocarcinoma)." Page 275: "Psammoma is a term often applied to tumors containing calcified hyaline concretions. Such sand-like material may occur in a variety of tumors, for example, dural endothelioma, carcinoma of the ovary, carcinoma of antrum of Highmore."

HISTORY OF CASE

A married woman, with negative family and past history, began, in 1914, at the age of 40, to have epigastric distress, with constant soreness and a "heavy feeling" in the pit of the stomach. She was treated for several months for "nervous indigestion" without relief. Then a course of "gastric ferments" was given without result. In July, of the same year, the abdomen began to enlarge rapidly, and 6 gallons of fluid were removed by tapping. At about the same time a laparotomy was performed, the following report being furnished by the surgeon: "She had tubercular peritonitis. Peritoneal cavity contained considerable free fluid; there were many small tubercles. Tubes and ovaries were tuberculous and matted together, so that removal was impossible. The fluid was evacuated, and the abdominal wall closed without drainage."

Ten days following the first tapping a small lump appeared at the site of the puncture and grew slowly —it never went away.

Patient was quite well, following operation, until September, 1915, when she entered another hospital with fluid in the left chest, and 6 pints (?) were withdrawn. The following month in still another hospital, she was "sweated until she was unconscious," in a vain attempt to rid her of the fluid; then the left chest was tapped again. There followed three aspirations in the next 6 months, and in May, 1916, fluid had to be withdrawn from both chests and abdomen. Thereafter until March, 1917, the left chest was tapped every 2 weeks. The report given us by the attending physician at that time is of interest:

"Found coffee-colored fluid in left pleural cavity and reddish fluid on right. Physical examination after tapping showed no very marked abnormality and X-ray showed only increased hilus shadows on both sides with streaks extending from hilus across the chest and down to the diaphragm. She did not respond to 0.1 milligrams of tuberculin, but gave a moderate general re-action to 1.0 milligrams, Wasserman test of blood negative. Tapping of the left side in ordinary manner gave rise to excessive pain probably on account of dislocation of mediastinum. I have, therefore, been preceding the evacuation by hypodermic of ⅛ gram of morphine and have allowed the oxygen to flow in as the fluid flowed out, finishing with the intrapleural pressure equal to that of the atmosphere. The fluid on the left accumulated promptly; on the right it required longer intervals to accumulate, but whenever present lead to great subjective distress. Only when the ascites was excessive was it necessary to evacuate the fluid.

"I have tried repeated reinjections of fluids without results. Tuberculin therapy has also been used without avail. I have taken her condition to be tuberculous in origin although sputum has always been negative and repeated guinea-pig inoculations with pleuritic fluid did not affect the animals."

From March to August, 1917, with the exception of 5 weeks at the Massachusetts General Hospital, the patient was under the care of her local physician, who during this time aspirated the left chest every other day, removing at each time an average of 28 ounces; and the right chest every 2 weeks, removing an average of 22 ounces. During her stay at the Massachusetts General Hospital, a small nodule was excised from the abdominal wall and the true diagnosis first arrived at: "Metastatic adenocarcinoma, probably primary in the ovary."

On August 30, 1917, she entered the House of the Good Samaritan, Boston. On entrance physical examination showed an anæmic, emaciated woman. Head and neck essentially negative. The findings in the *chest* were those of double hydrothorax. Nothing abnormal was made out in the heart. The abdomen was distended, wall thickened. In the left lower quadrant and the right lower quadrant were two hard firm masses in the abdominal wall. Deep palpation was entirely unsatisfactory because of tenderness. Urine negative. Hæmoglobin 80 per cent.

From August, 1917, to November 14, 1918, patient was in House of the Good Samaritan under purely palliative treatment. Diuretics, digitalis, and potassium iodide failed to give any relief. Both chests were aspirated at decreasing intervals until discharge, November 14, 1918, to Huntington Cancer Hospital. During this time the patient complained of cramp-like pain in abdomen and occasionally vomited. November 14, 1918, discharged to Huntington Hospital.

From November 14, 1918, to January 3, 1919, was at Huntington Cancer Hospital where a few *radium treatments* were given with some reduction in size of masses in skin, while the chest tappings continued as before but much more frequently.

January 3, 1919, re-admitted from Huntington Hospital. Examination about as before but patient seemed worse. Tappings now were done every day or every second day on left chest and every third day on right chest, obtaining from 200 to 800 cubic centimeters each time. Patient sometimes complained of severe colic-like pains with nausea, sometimes with vomiting. At intervals she had several radium treatments at Huntington Hospital as an out-patient. On July 12, 1919, under novocaine a mass was excised from abdominal wall in order to forestall its breaking down. In evening hæmorrhage into wound necessitated second operation. Pathological examination of the excised tumor showed the growth to be an "ovarian psammocarcinoma."

Patient was much weakened as a result of loss of blood and steadily failed. Fluid from left chest had been bloody at intervals before but now was distinctly more so.

Patient died quietly on August 17, 1919.

Section was performed one hour and ten minutes postmortem by Dr. Ward H. Cook, and following is the report:

Anatomical diagnosis. Carcinoma (scirrhous carcinoma) psammocarcinoma and papillary adenocystoma involving peritoneum, pelvic viscera, abdominal wall, intestines, omentum and pleuræ, with partial obliteration of the cavities. Accessory spleen. Chronic hyperplastic perisplenitis, perihepatitis and pleuritis. Hæmothorax, left. Laparotomy scar. Atelectasis of left lung. Œdema of right lung. Fatty liver. Thrombosis of pulmonary artery. Dilatation of heart. Chronic endocarditis with mitral insufficiency.

Microscopic diagnosis. Papillary cystoma of ovary with metastasis of peritoneum, intestines, diaphragm, pleuræ, omentum, and abdominal wall. The tumors show a markedly infiltrative tendency, becoming, however, often scirrhous, and on account of calcification exhibit the so-called *psammocarcinoma* type of growth. Mitoses are few.

Summary of tappings. We know definitely the total number of times that aspiration was performed and we know accurately the amount of fluid withdrawn while patient was in the House of the Good Samaritan, by far the larger part of the total. The amount withdrawn at other times, however, is in a small part estimated. We feel that we are justified in so doing, and that where it has been done so many times our deductions are accurate; therefore we feel satisfied, in presenting the figures, that they are not far from being a true presentation of the case.

Total chest tappings, 862; fluid, 475,700 cubic centimeters.

Total left side, 603; fluid, 357,300 cubic centimeters.

Total right side, 259; fluid, 118,400 cubic centimeters.

Total abdominal tappings, 20; fluid (estimate) 120,000 cubic centimeters. The grand total then is 882 tappings, with the removal of approximately 600,000 cubic centimeters of fluid.

COMPRESSIVE TRAUMA AS AN ENTITY

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In spite of the recent additions to our knowledge of the injuries and infections of the locomotor organs, and despite the improvement in the diagnosis, and the treatment of the diseases and injuries of these organs, delayed and even permanently impaired function is still not an unusual result of these conditions. No doubt faulty alignment and non-union following fractures are not so frequent as formerly but the duration of the treatment, particularly the after-care, and the time that elapses before the affected individual is able to resume his usual avocation, is considerable, and to those engaged in manual labor, a source of unrest and great financial loss. This does not by any means imply that all the excellent work on the treatment of fractures that has been done during the past decade is valueless. The contrary is true. Nearly all the recent investigations, however, have been directed toward the improvement of the technique of reduction and the maintenance of the fragments in apposition, though it is well known to experienced surgeons that delayed restoration and permanent loss of function after fractures is due to faulty or non-union in only a small proportion of the cases.

Having to deal with material, a large part of which comprises individuals in whom early restoration is imperative, I have long felt that a better knowledge of the morbid conditions which result from trauma to a limb as a whole, is necessary if the duration of the treatment is to be curtailed and the functional results following fractures are to be improved. As I found only scattered allusions in the periodic literature and only very perfunctory descriptions in the textbooks, I began some years ago, the clinical and experimental studies I am about to describe.

If we exclude for the present those cases of concomitant injury to a large blood-vessel or nerve trunk, we find that irrespective of consolidation, delayed functional recovery after fractures is caused by one or a combination of several of the following clinical conditions:

1. More or less marked and persistent neuromuscular, neurotrophic and vasomotor disturbance.

2. Inhibition of joint motion with signs of intra-articular injury and intra-articular and peri-articular inflammation.

3. Inhibition of joint motion without signs of intra- or peri-articular injury and inflammation, or those in which intra- or peri-articular inflammation appears with the attempt to re-establish joint mobility.

The signs of injury to an important vessel or complete interruption of conduction in a nerve are so definite that these cases are easily recognized and need not concern us at the present time. There are, however, numerous cases of delayed restoration of function, mild and severe, in which there is often difficulty in allocating the various symptoms of muscular and nerve injury without actual interruption, to definite morbid conditions. This is particularly true of the neuritic phenomena which occur in fractures and injuries of the extremities. These cases may be classified into three groups:

Group 1. In fractures of the distal parts of the extremities we frequently meet with cases in which the bones are firmly united in good position, though swelling, pain and mild neurotrophic disturbances such as glossy skin, hyperidrosis, etc., persist. As there are no definite localized disturbances of sensation or motor abnormalities which can be ascribed to a lesion in a particular nerve trunk, the morbid conditions in such cases are usually undetermined. Figure 1 illustrates such a condition following fracture of the radius and ulna, lower third. In this case the bones are united in good position but there is persistent neurotrophic disturbance, swelling, pigmentation, hyperidrosis, pain, and impaired mobility of wrist and finger joints, but no deformity.

Group 2. In another group of analagous cases, the symptoms of neuromuscular in-

volvement are more marked and persistent. In some of these the symptoms can more readily be ascribed to a lesion or irritation of a definite nerve trunk. Thus we have cases of neurotrophic or vasomotor disturbance, glossy skin, hyperidrosis, etc., with pes equinus following fractures and injuries of the lower extremity. Such conditions following injuries of the upper extremities are even more definite and frequent. Here, besides the other neurotrophic and vasomotor abnormalities, we have the characteristic deformities due to lesions or irritation of the various nerves. In such conditions, however, the deformities do not correspond to interruption of a nerve trunk; on the contrary the attitude assumed by the limb, as in cases of neuritis or perineuritis, may be said to be characteristic of overactivity (extreme spasticity) in a group of muscles supplied by a nerve trunk. Thus the deformity is paradoxical simulating more or less exactly a condition which usually ensues when an antagonistic group of muscles is paralyzed, whereas in the cases now under discussion, no paralysis exists. Thus Figure 2 is the photograph of the hand of a case of fracture of the radius and ulna, 5 months after the injury. There is some atrophy but no paralysis of the interossei. The deformity is due to the contracture in the tendons of the extensor digitorum longus which supplies the middle and ring fingers. Motion, active and passive, of the wrist and all the fingers is somewhat but not entirely restricted. Passive motion is painful, and voluntary motion is weak. In some of these cases there are the signs of typical neuritis, though the affected nerve is not in proximity to the fracture or involved in the callus. Thus Figure 3 is the photograph of the hand of a patient who sustained a fracture of the radius and ulna about 6 months previously. The fracture is united in good position. Supination is lost, there is the fixation of the terminal phalanges, the neurotrophic disturbances and the griffe of median neuritis, though the median nerve was not involved in the fracture or in the callus. Although these deformities are perfectly characteristic in a certain percentage of the cases, the spasticity which produces joint deformity and is not infrequently followed by fibrosis and shortening, more often involves muscles or groups of muscles not supplied by the same nerve trunk, and the sensory, vasomotor and neurotrophic disturbances are irregularly distributed.

Finally we have Group 3, the cases usually designated as "ischæmic paralysis," von Volkmann's paralysis."

This grouping it must be understood is arbitrary and used here simply for convenience in description. The same clinical phenomena are represented to a variable degree in all three groups and there are no well defined limits, but a gradual transition depending upon the severity and the location of the injury, between them. This irregularity in the distribution of the neuromuscular and neurotrophic abnormalities is well illustrated in Figure 4, the photograph of a patient with a fracture of the radius and ulna, the result of a motor car accident. There is contracture of the palmar fascia and flexor tendons, fibrous ankylosis of the terminal phalangeal joints, and the neurotrophic disturbance of median neuritis; marked weakness of the extensors of the wrist and fingers, the interosseii, the thenar and hypothenar muscles.

In order to determine definitely, the morbid conditions in these cases and to decide a number of questions, still the subject of controversy, the following series of experiments were undertaken:

1. Animals were subjected to increasingly severe traumata to produce contusion without fracture.

2. The force employed was increased to produce fracture by direct violence.

3. Animals were subjcted to violence to produce contusion and laceration without suppuration.

4. Animals were similarily contused and lacerated and the wound permitted to suppurate.

5. Animals were subjected to forces to produce fracture by indirect violence.

1. Twelve young dogs were subjected to trauma, a single blow from a steel rod (1½ by ⅛ by 8 inches) on the posterior lateral surface of the thigh. The severity of the violence in an ascending scale was produced, by gradually increasing the power of the

blow in the different animals but in no case was the blow violent enough to produce noticeable injury to the bone. Four of the animals (the 2nd, 4th, 6th, and 8th, the numerals representing the animals and at the same time the degree of the trauma) were killed a few minutes after the injury was inflicted. The others were killed at intervals of from 3 days to 2 weeks.

It was found that moderate violence produced no laceration except in the subcutaneous areolar connective tissues. As the capillary blood supply runs in this tissue there was usually some injury to these vessels and a corresponding ecchymosis. These changes became more pronounced but similar in character and distribution with increasingly violent traumata. When the blow was so powerful that any increase in the force applied would produce fracture of the femur, the changes were not only more marked but they also involved the more important structures of the limb. Not infrequently vessels of fair caliber, and as a rule many of them within the intramuscular septa, were torn. Obviously there was then a marked extravasation of blood which distended the tissue spaces and the hæmorrhage moreover extended to a considerable distance from the seat of injury.

Though muscular tissue only occasionally showed definite macroscopic tears as a result of moderate trauma, there was practically always marked hæmorrhagic infiltration which extended a considerable distance on all sides of the site of trauma involving all the muscles in the neighborhood. In no instance was there demonstrable injury to the nerve trunks. Not infrequently, however, the nerve sheaths, not only in the immediate neighborhood but sometimes at some distance from the site of the insult showed evidence of hæmorrhage and in cases examined a few days after the injury they were occasionally found imbedded in a sizable blood clot.

As the findings in the animals subjected to severe trauma without fracture, differed only slightly from those found in animals subjected to traumata sufficiently great to produce fracture, I shall discuss them with the latter conditions.

In May, 1918, I subjected 12 adolescent dogs and 12 rabbits to trauma, a single blow over the lateral surface of the thigh with the rod used in the previous experiments, sufficiently powerful to cause fracture of the femur. These experiments were repeated on 12 rabbits early in September, 1919. In all the animals examined immediately after the injury there was evidence of profuse hæmorrhage. The extravasated blood extended along the fascial planes for long distances and though the fracture always involved very nearly the middle of the femur, it could, not infrequently, be traced to either the hip or knee or both these joints. Besides the hæmorrhage which is due to the laceration of the vessels in the immediate neighborhood, there are often hæmorrhagic areas that apparently have no direct connection with the lacerations caused by the initial blow. These hæmorrhages occur within the depths and are often found within the muscles. As such hæmorrhages cannot be ascribed to the actual impact, it must be assumed that they are caused by concussion (Figs. 5 and 6).

A short time after the injury, the extravasated blood was found within the muscle tissue as well as in the fascial planes, and subsequently blood clots were found under both the epimysium and perimysium. Thus the muscle tissue presented a variable appearance corresponding to some extent with the distance from the area which received the impact. In the immediate vicinity of the trauma where the muscle tissue was nearly always torn, it was practically the same color as the blood clot; it became gradually lighter in color as the distance from this area increased except where there were additional hæmorrhages, when it again became livid. The extravasation of blood came not only from the injured vessels in the soft tissues but there was in addition, nearly always oozing from the fractured bone. The latter may continue for some time, and when the fracture is near the nutrient vessels, the hæmorrhage is likely to be very profuse. From the medulla and from torn periosteal vessels the blood often found its way between the bone and the periosteum; the latter became separated from its attachment often for a considerable distance and in two instances the subsequent blood clot was found to extend to the capsule of the hip-joint (Fig. 7).

In none of the cases could I demonstrate actual laceration of a sizable nerve trunk macroscopically. In the majority of cases, nerve trunks were surrounded by extravasated blood and subsequently imbedded in the blood clot. In three dogs, in whom the bones were much harder than in rabbits, requiring considerably more violence to fracture, the sciatic, to and beyond its bifurcation, was found imbedded in a large blood clot (Fig. 8). Moreover, hæmorrhage within the sheath was not an unusual finding a few days after injury, in rabbits as well as dogs.

All these violent traumata were followed by a very marked inflammatory reaction. The tissues not only in the neighborhood of the impact but for long distances in all directions were greatly swollen and congested. After a few days there was a profuse exudate which extended in all directions in the fascial planes, between the intramuscular septa and the perivascular and perineural spaces, greatly distending the tissue spaces. As a result of the compression from the exudate and the laceration due to the trauma, the muscular tissue in the immediate vicinity of the injury became necrotic, and the veins near and distant from the traumatized area contained thrombi and showed evidence of phlebitis. In some instances the inflammation could be traced well up to the joint structures which take their origin from the affected bone, and in one

Fig. 1. Persistent swelling, pigmentation, hyperidrosis, pain and impaired mobility of the wrist and fingers but no deformity, following fracture of the radius and ulna united in good position.

Fig. 2. Delayed return of function after fracture of the radius and ulna by direct violence; atrophy and weakness of the interossei; active and passive motion of the wrist and fingers, restricted and painful; the deformity is due to contracture of the extensor longus digitorum of the middle and ring fingers. Injury 5 months ago.

case, though the fracture was well up in the femur, the periarticular structures of the knee were definitely involved in the inflammatory process.

Microscopical examination. In the most insignificant injuries, only minute lacerations in the perivascular areolar connective tissue and capillary hæmorrhage could be demonstrated immediately after the injury; subsequently there was a mild perivascular inflammation which soon resolved. When the trauma was at all considerable, histological examination showed the injury to be much greater than one is led to believe by macroscopical examination. Even in moderate trauma, veins of fair caliber were found filled with thrombi and in the cases severely injured, large vessels were completely occluded long distances from the traumatized area.

The microscopic changes in the muscles vary; they may be grouped under two heads: (1) lacerations and necrosis due to the direct injury; (2) degeneration of the fibers apparently due to the compression of the extravasated blood or the inflammatory exudate.

Lacerations involving a few fibers were very constant in all cases in which the force used was at all violent; as a matter of fact, it was found to be very difficult to reduce the violence to such proportions that at least some microscopic muscle fiber laceration could be avoided if the blow was forcible enough to produce any changes at all. In severe traumata, many lacerated muscular fibers were found even when macroscopic tears were insignificant or apparently entirely absent. The torn fibers always undergo necrosis. Besides the lacerated and necrotic muscle fibers, there were found numerous muscular fibers which had undergone degeneration. The number of degenerated fibers depended upon the severity of the trauma and the distance from the area of impact; but the character of the degeneration (vacuolization and hyaline degeneration) bore no relation to these factors. In moderate traumata, degenerated fibers could, not infrequently, be demonstrated when actual tears were absent and from this I think it must be concluded that the compression from the exudate is sufficient to produce degenerative changes though the muscles are not injured by the blow.

The microscopical changes in the nerves, like those of the muscle fibers were even more marked than examination by the naked eye would lead one to suspect. Aside from the cases severely traumatized, in which the perineural hæmorrhage was demonstrable macroscopically, perineural hæmorrhage involving numerous fine branches could be demonstrated in sections taken from animals soon after the injury. Later, perineural inflammation was very common in all but the mildest traumata. At times there were found extravasations of blood or clots within the sheath of sizable nerves and occasionally these conditions were found at some distance from the traumatized area. In the severe traumata besides the above mentioned changes, numerous fine nerve branches were found to have undergone degeneration.

The pathological conditions found in the animals experimented upon show that the injury to the vascular and neuromuscular apparatus, the result of trauma, is much greater and more extensive than one would be led to suspect from macroscopical examination of the tissues or the external appearance of the injured member immediately after the injury. Hence it must be assumed that in the human subject, compressive injuries violent or long continued enough to produce fracture, always induce considerable injury to the soft parts, involving not only immediate vicinity of traumatized area, but extending a greater distance than heretofore suspected.

Knowing the pathological conditions, it is not difficult to understand the peculiarities of

Fig. 3. Loss of supination, neurotrophic disturbance and griffe of median neuritis 5 months after fracture of the radius and ulna with union in good position. The median nerve is not included in the callus.

Fig. 4. Irregularly distributed nerve abnormalities in a case of fracture of the radius and ulna by direct violence. There is contracture of the palmar fascia and flexor tendons, fibrous ankylosis of the terminal phalangeal joints, and the neurotrophic disturbance of median neuritis; marked weakness of the extensors of the wrist and fingers, the interossei, the thenar and hypothenar muscles.

the clinical phenomena in many of the cases met with in practice. Neuromuscular, neurotrophic and neurovascular disturbances are due to one of two conditions or both. The vessels are always injured; and the neuromuscular structures may be directly involved in the trauma, or they may suffer as a result of the compression due to the extravasation or the secondary inflammatory exudate. The clinical manifestations will vary with the location of the trauma, its violence, and the severity and extent of the secondary inflammation. The morbid conditions in the moderate traumata may involve one or more nerve trunks or their important branches but in the majority of cases only the fine nerve branches and the muscle fibers themselves are affected. Consequently the clinical manifestations in these cases, rarely correspond to injury of a single nerve trunk, but consist of irregularly distributed sensory, neuromotor, and neurotrophic disturbances.

In the more decided traumata, the muscle fibers are apt to be lacerated; there is marked compression of the terminal nerve fibers; and large nerve branches or nerve trunks are often included in the hæmorrhage and inflammation. In these the clinical manifestations are more marked, more extensive and more persistent, likely to include those of nerve trunk lesions and to be followed by more or less joint deformity. The muscular retraction and the character of the resultant joint deformity are the result of a combination of lesions in the muscles, nerve terminals and nerve trunks. As these combinations are endless, the ultimate deformity presents the numerous variations with which we are familiar.

Moreover the deformation is greatly influenced by the position of the limb during the activity of the inflammatory process. Dressings may inhibit or exaggerate the tendency to deformity and they may permit shortening of muscles not actually involved in the morbid process. Thus a cock-up splint will greatly increase the tendency to the claw hand of ulna paralysis, and a splint which permits the arm to remain pronated frequently leads to loss of supination although neither the biceps nor the musculocutaneous nerves are involved in the trauma or the reactive inflammation.

In the extremely violent traumata, the muscle tissue is found to be almost completely severed within, and necrotic to a considerable distance from the traumatized area. Numerous vessels in the neighborhood and at a distance are also torn, and many of the large vessels at a distance are filled with thrombi. Thus the area involved is not only directly injured by the trauma, but in addition loses the greater part of its blood supply. As large gaps in muscle tissue are first obliterated by connective tissue, which only long after becomes replaced by regenerated muscle fibers even in favorable cases, the loss of blood supply undoubtedly retards the regenerative process, or holds it entirely in

Fig. 5. Marked extravasation due to both deep and subcutaneous hæmorrhage after fracture by direct violence —rabbit. The limb is cut across at the site of the fracture. Fixed in Jorres solution. At *a* a nerve branch has been dissected out of the blood clot.

Fig. 6. Extravasation extending beyond the knee-joint following fracture by direct violence of the middle third of the femur—rabbit. The hæmorrhage is deep and was not evident until the skin was removed. Fixed in Jorres solution. The extravasation and blood clot are represented by the dark areas.

abeyance. The ultimate result in the most serious cases, then, will be the substitution of scar tissue for the muscle fibers which have been lost. This scar tissue involves not only the muscle tissue but all the subcutaneous tissues down to the bone, and the skin, muscles, nerves and blood-vessels become bound together in a mass of dense, contracted connective tissue. Evidently the condition known as Volkmann's ischæmic paralysis is induced in this way. Certainly the findings in these cases correspond exactly to the morbid conditions just described. In practically all the cases recorded, the fracture was caused by direct violence, which was soon followed by severe pain, considerable swelling and inflammation, and the formation of a contracting cicatrix, binding down all the subcutaneous tissues, a sequence of phenomena exactly analagous to those produced experimentally.

It is not as has been assumed, a constricting dressing therefore, which causes ischæmic paralysis. Though it is true that a tight bandage is exceedingly harmful in all cases of compressive trauma (such a dressing obviously nullifies the benefit to be obtained from the elasticity of the tissues when the hæmorrhage or the exudate is excessive), the experiments here recorded, demonstrate that violent trauma directly over muscle tissue, is in itself sufficient to cause the morbid changes responsible for ischæmic palsy. It must be admitted, however, that improper dressings, though not wholly responsible for it by increasing the subcutaneous tension, certainly increase the inherent gravity of the condition and thus sometimes favor the occurrence of serious disability which under favorable conditions might have been avoided.

In order to determine the morbid conditions of compressive traumata complicated by non-suppurative and suppurative open wounds, a third series of experiments was undertaken.

In this series, six young dogs were subjected to trauma, as in the previous experiments. Immediately thereafter a wound sufficiently deep to penetrate the muscle was made with a sterile, sharp saw. The wound immediately received a sterile dressing and all but one of these animals remained uninfected. Eight dogs were similarly traumatized and wounded and the wounds were left open and subsequently

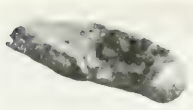

Fig. 7. Hæmorrhage involving the capsule of the hip-joint due to fracture by direct violence, of the middle of the femur—rabbit. Fixed in Jorres solution. The extravasated blood and clot are shown as dark areas in the illustration.

suppurated. In the first five dogs whose wounds remained uninfected, the morbid conditions found at autopsy both macroscopical and microscopical were practically identical with those found in dogs similarly traumatized without an open wound. As a matter of fact the condition in the soft tissues in several of the cases was even less extensive and the secondary inflammation less violent than in the dogs with simple but equally violent contusions, with and without fracture. This I ascribe to the fact that in all the dogs with open wounds, the oozing from the wound was considerable and continued for several days. Thus the pressure from the extravasation and inflammatory exudate was considerably reduced and the damage to the tissues from this cause at least, partly inhibited.

Nor did the conditions in the eight dogs purposely and the one dog accidently infected, as far as muscles and nerves were concerned, differ radically from those found in the noninfected animals except in certain minor details. In the infected animals, the muscle tissue severely traumatized, was necrotic and degenerated as in the others, but there was besides an extensive suppurative myositis with the usual changes. Suppuration followed the fascial planes and whenever extensive enough involved the tendon sheaths. Thus, though the danger to life is greater in the cases complicated by open or suppurating wounds (four dogs dying of general infection within two weeks), the local changes are not influenced to any great extent by these complications.

In order to determine whether the morbid condition of the soft parts here described is caused or influenced by the fracture, twelve dogs were subjected to fracture of the femur and eight to fracture of the tibia, by indirect violence, and the soft tissues examined. Though vascular injury and some medullary oozing was often present as a result of these injuries, the phenomena here described as characteristic of contusive injuries, were entirely absent or insignificant when compared to those induced by direct violence. It is evident, then, that the break in the bone is not responsible for the morbid condition in the soft parts.

It is plain, therefore, that fractures by direct violence must be distinguished from those caused by indirect violence, not only as has heretofore been the custom because of the difference in the character of the break in the bone, but because those due to direct

Fig. 8. Sciatic nerve, to and beyond the bifurcation imbedded in a large blood clot. Fracture by direct violence of the middle third of the femur. The nerve has been freed from the blood clot; the bifurcation still remains partly included. Fixed in Jorres solution.

violence are accompanied by morbid conditions in the soft parts often as important, sometimes even more important as causes of prolonged or permanent disability, than fracture.

The causative moment in these cases is the compression of the tissues. The severity of the morbid conditions will depend upon the intensity of the trauma, and its duration and the tissues involved will depend upon its location, *i. e.*, the point of application and the vulnerability of the tissues acted upon by the compressive force. Obviously, the soft tissues are more vulnerable than the bones, and of the soft tissues, the smaller veins, muscle fibers and delicate nerve fibers and endorgans are more likely to be injured than the denser connective tissues. When, therefore, fracture by compression occurs, it must be assumed that the compression has been maximal and that all the soft tissues within the compressed area have been seriously injured. Only those tissues not in the line or area of impact will escape. On the other hand, as the soft tissues are more vulnerable than the bone, it is evident that these tissues are liable to injury from compressive force not sufficiently great to produce fracture. In the latter, the condition is usually designated a contusion. If it is remembered that a considerable compressive force may be so located that the bones are not in the line of impact, the reason why contusions sometimes lead to even more serious disability than fractures, is clear.

Obviously a large proportion of the factory accidents are compressive injuries whether they are or are not complicated by fracture, open wounds or suppuration. Though not so obvious, it is nevertheless demonstrable upon mechanical grounds that gunshot, especially shell injuries are concussive and hence cause compressive injuries. If we exclude, just as we did in the case of fractures, those cases in which there is evidently complete nerve interruption, the large number of cases of neuromuscular disturbance and paradoxical deformity reported, the large number of cases in which nerve trunk or trunks are found imbedded in the blood clot or scar tissue without actual injury, at operations, and the large number of cases of muscular atrophy and deformity due to disregard of position of the limb and the character of the morbid process during the active stage, the assumption is borne out that these war injuries are analagous to all other compressive traumata. Indeed as gunshot injuries lead to the same ultimate disabilities, irrespective of the complications (fracture, laceration, suppuration), present the same clinical phenomena in the soft tissues, and offer opportunities for subjecting the soft tissues to violent traumata, without involving the bone, these cases not infrequently present the characteristics of compressive injuries, even more definitely than the cases from civil life.

CONCLUSIONS

Thus the investigations here recorded, lead us to the following conclusion: Compressive injuries of the extremities must be distinguished as a special group of morbid conditions. Aside from the coincident or complicating conditions, they have a common etiological moment, a common pathology, and are likely to lead to analagous disabilities. Though the morbid conditions induced by the compressive force often involve the bone and may be complicated by wounds and suppuration, the changes in the soft parts are uniformly characteristic. As gunshot and particularly shell wounds, are virtually compressive injuries (what is lost in duration and weight of missile is more than compensated for by the velocity) presenting the same morbid conditions and the same train of symptoms, these injuries must be included here.

The morbid condition induced by compressive injury is twofold: it consists of the direct injury to the tissue at the time the force is applied; and the additional injury caused by the increased tension within the tissue, the result of the extravasation of blood and the inflammatory exudate. The secondary compression, as it often involves the muscle and nerve fibers with their endorgans, tissues exceedingly sensitive to compression and irritation, often leads to disabilities entirely out of proportion to the damage produced by the original compressing force. As the damage to the neuromuscular and vascular apparatus is regional, depending upon the severity and the location of the impact, the clinical phenomena are usually not characteristic of a nerve trunk injury.

Ischæmic paralysis is the most serious form of compressive injury. It is due to a combination of neuromuscular and vascular injury; and the morbid condition only differs from that caused by all compressive injuries, in its intensity and wider distribution. Ischæmic paralysis is not necessarily caused by a constricting bandage; though such a bandage increases the tendency to this condition, the causative factor more often lies in the intensity of the exciting compressive trauma.

The coincidence of fracture, open or suppurating wounds, only slightly influences the effect of the compression; these complications increase the seriousness but do not alter fundamental character of morbid condition.

These conclusions have a very important bearing upon the treatment of these injuries. If gunshot injuries, fractures by direct violence and all contusions (so called) are characterized by the same morbid phenomena in the soft tissues, it is evident that the soft tissues will, if prolonged or permanent disabilities are to be avoided, require the same attention as the wound or the fracture. Moreover, as the morbid conditions described above come on immediately or soon after the injury, the necessary treatment cannot be delayed until the fracture has been consolidated, suppuration has subsided or the wound has closed. It must be instituted from the beginning.

THE RESULT AND FEASIBILITY OF TREATING LYMPHANGIOMATA WITH INJECTIONS OF BOILING WATER[1]

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THE characteristics of lymphangiomata are such that no matter what the variety—nævoid, cavernous, or cystic — their amenability to treatment furnishes a very unsatisfactory chapter in surgery. Fortunately these lymphatic tumors are not common. They are far less frequently observed than blood angiomata to which they bear a close relationship, the difference lying principally in the nature of the contents of the vessels or spaces.

In my service of 10 years at the City Hospital, an institution of one thousand beds, I have had occasion to observe only 4 cases. The scarcity of patients affected with true lymphangiomatous growths seeking hospital care must be ascribed to some extent to the fact that these tumors seldom threaten life, that they do not cause pain, and do not cause the afflicted person to feel ill. Furthermore, lymphangiomata are usually congenital, and quite naturally a mother hesitates to take her babe to a hospital because it has a small tumor mass somewhere on the body which does not cause pain.

When confronted with a tumor of any sort, the thought uppermost in the surgeon's mind is whether or not the growth is suitable for excision. Extirpation is the radical and most satisfactory measure in the treatment of lymphangioma, if the operation can be safely executed. In that form of nævoid lymphangioma affecting the tongue, causing marked enlargement of that organ, and forcing it to protrude from the mouth (macroglossia), partial removal by cuneiform excision is peremptorily the only measure, even at the risk of causing progressive inflammation or lymph fistulæ.

A similar procedure, but with greater risk, can be undertaken when the disease has attacked the lip (macrocheilia). It is an expedient that carries with it the danger of extensive infection or exhaustive lymphorrhœa and in lieu of the unsatisfactory results occurring from the operation it is to be recommended only in extreme conditions.

The cystic lymphangioma, the simple lymphatic cyst, usually found in the neck is perhaps the safest tumor to extirpate. Such a tumor can usually be dissected with little difficulty as it is not intimately adherent to other structures.

In contradistinction to these simple lymphatic cysts is the cavernous lymphangioma, also found in the neck. This type of tumor differs from the single lymphatic cyst in that in addition to lymph it contains a certain amount of solid tissue, and is frequently of a mixed structure, being both hæmangiomatous and lymphangiomatous. These tumors may attain a large size, show an absence of encapsulation, and are adherent to important structures which render their excision extremely hazardous and often impossible. The cavernous lymphangioma is the most frequent of the species, and may occur in almost any part of the body. The lesion is usually found in the tongue, lips, eyelids, cheeks, lateral regions of the neck, pectoral region, and upon the upper and lower extremities, particularly the hands (macrocheiria) including the fingers (macrodactylia) and the feet (macropodia) including the toes. As a rule these tumors are ill defined, as they do not present a sharp contour at their base. The tumor appears to become continuous with the normal surroundings, its cavernous tissue infiltrating the skin, sending out cone-like processes between the muscles. displacing and surrounding nerves and blood-vessels.

To attack such a growth with a scalpel would unquestionably invite disaster of some sort. It is still a mooted question as to whether or not the best advice is not to interfere. An experience gleaned from 16 cases inclines me quite willingly to abide by this advice. Nature in course of time is often most helpful in causing these growths to diminish in size or disappear entirely. The tumors

[1]Presented before the Southern Surgical Association, New Orleans, December 16, 17, and 18, 1919.

Fig. 1. Lymphangioma of right hand, thumb, and all fingers, except little finger. At left, dorsal surface; at right, palmar surface. One injection of hot water was given. A severe phlegmonous inflammation developed. Three months later the hand and thumb showed a marked decrease in size (about one-half) but the fingers gave little evidence of decrease.

Fig. 2. Lymphangioma of left foot involving all the toes. Two injections of hot water were given at a three months' interim. One year after the last injection the lymphangiomatous swelling had decreased two-thirds its original size. Shrinkage of toes was less marked.

Fig. 3. Lymphangioma of left leg immediately above ankle on inner side. The lymphangiomatous swelling involved the foot and all the toes. One injection of hot water caused shrinkage of the tumor to one-half its original size, 6 months later.

are very susceptible to microbic influences and at times become inflamed. During such periods the tumors become swollen and tender, the skin overlying them becomes red, and the patient frequently shows a rise in temperature. An active suppurative process seldom results. After a period of inflammation has subsided, it is often found that the tumor has diminished in size. Repeated periods of inflammation may cause the tumor to disappear entirely, leaving a mass of scar tissue.

In connection with these unusual inflammatory processes, I wish to mention the cases of two babies both affected with a cavernous lymphangioma of the left cheek. One of the babies was stung on the affected cheek by an insect. A sharp inflammatory reaction ensued, and the tumor enlarged perceptibly. Six weeks later, after the inflammation had subsided, the tumor was found to have decreased fully one-third in size.

In the other case the condition of the cheek was not recognized and the physician made a half inch incision into the most prominent part of the swelling. For 3 weeks a clear, sticky fluid exuded. The wound in the meantime became infected. The cheek enlarged to twice its size, the swelling extending well upon the neck. In two months the inflammatory condition subsided and the check was found to be reduced about one-half. This child was very sick and came near perishing.

It appears that a cavernous lymphangioma is particularly susceptible to inflammation of a phlegmonous type but rarely evidences suppuration. Only when, through a mistaken diagnosis, an incision is made into the tumor affording an opportunity for the ingress of pyogenic microbes, may a suppurative inflammation of the walls of the infected lymph channels and the interstitial connective tissue ensue. An infection produced in this manner may become very severe and involve the entire tumor, and all the risks to life incident to sepsis and pyæmia may be present. Because of the possibility of inviting surgical calamity, these tumors are being looked upon as inoperable.

Although a cavernous lymphangioma is of slow growth, often remaining stationary for some time, at times even decreasing in size, it may grow rapidly. It is usually during the progressive enlargement of the tumor that relief is sought for the patient.

In an endeavor to imitate nature's course in destroying these tumors through simple inflammatory processes, injections into the tumor, of alcohol, of tincture of iodine, and 1 per cent solution of zinc chloride have been instituted. The object of these injections is to produce an aseptic thrombosis which will render the affected part of the tumor harder and cause an arrest of growth. Although this measure seems logical, I believe that the solutions mentioned are only severe

Fig. 4. Simple cystic lymphangioma of neck, removed by excision.

chemical irritants and entirely too drastic to be injected into so sensitive a mass.

A lymphangioma is analogous to an angioma, and as I have had most gratifying results with hot water injections in the latter, it occurred to me to use the injection method in treating lymphangiomata as was done in treating hæmangiomata. So far 8 cases have been injected with boiling water. Comparison of the results obtained in treating lymphangiomata with those of hæmangiomata is somewhat disappointing. This must be attributed to the difference in the fluids in these tumors. The solid tissue elements of the hæmangiomata are more sensitive to favorable metamorphic changes than is the soft tissue of the lymphangioma. It was found difficult to transform the soft tumor of a lymphangioma into a solid mass so that the boiling water could be introduced only under strong pressure, thus endangering the adjoining tissue. Furthermore, it was difficult to judge when the tumor was sufficiently injected. The only skin sign which gave positive evidence was a slight, superficial, epidermic detachment. Such a result was not desirable inasmuch as it created an avenue of infection.

The reaction following the injection seemed unusually severe when compared with the reaction following an injection of an hæmangioma. For 24 hours the patient gave evidence of feeling ill and usually registered a temperature of 100° to 102° with a pulse of 100–110. When the reaction had passed off, which was usually after the third day, the feeling of euphoria returned. The increase in the size of the tumor following the injection, although considerable, was small when compared with the increase in size in hæmangiomata after injection. Inflammatory processes seemed active and prolonged, the skin giving evidence of the severity by discoloration. Retrogression seemed very slow; 4 to 6 months passed before the tumor showed a decrease in size. In the case of a lymphangioma of a baby's left foot which was enlarged to about four times its normal size. it was two years before the swelling of the foot decreased so that a shoe could be fitted to it. It is almost impossible to make second injections if the initial injection has been a thorough one; the tumor mass is so hard that no hot water can be forced into it.

It must be said that of the 8 cases injected with boiling water, all have been benefited: in none, however, has the tumor entirely disappeared. In 4 of the cases where the seat of the lymphangioma was under the pectoral muscle, on the flexor side of the forearm, or on the inner side of the leg, the growth was reduced more than two-thirds its original size. These were adult patients. In the case of a boy, 9 years old, with a tumor situated in the hollow of the external ear (concha), the growth almost entirely disappeared 9 months after the hot water injection. In 2 cases where the lymphangioma involved a hand, including thumb and several fingers, the resulting decrease of swelling was about one-half. The thumb and fingers, however, showed but little decrease. These patients were respectively 2 and 5 years of age.

In one case in which the left foot and all the toes showed a marked lymphangiomatous growth and the extremity was about three times the normal size, one injection reduced the swelling about one-half. The toes all showed some decrease, but the decrease in the

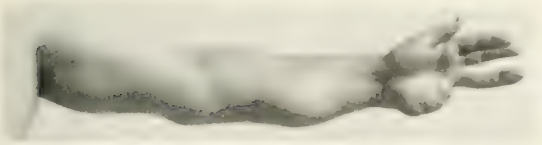

Fig. 5. Lymphangioma involving palmar aspect of left hand, ring finger, and inner aspect of forearm. The little finger on account of its large size was amputated 6 years ago at request of patient, it interfering with his work as a jeweler. He also asked that the ring finger be amputated, but this request was refused. One injection of hot water into the ring finger, the palm of hand, and the tumor on the forearm caused a shrinkage of the lymphangiomatous swelling fully one-half. He is now able to perform his work as a jeweler with greater facility. His condition did not bar him from entry into military service.

toes was much less than the decrease in size in the foot.

The clinical characteristics of a lymphangioma fully disappear after a hot water injection; instead of being a tumor, soft and of relaxed consistency, the boiling water converts it into a firm and hard mass. This is the change desired, as it prepares the tumor for absorption and obliterates the tendency to recurrent growth. Of this I can speak with certainty as none of the lymphangiomata injected has so far manifested any evidence of renewed growth, and some of these injections were made 6 years ago. Three cases of lymphangiomatous enlargement of the cheek in babies, which have come under my observation, were not injected as the objections by the parents were such as to make the risk and responsibility too great to attempt the undertaking. The case of a boy of 5 years may be cited as an illustration of the untoward consequences which may arise in the course of the treatment of a lymphangioma injected with boiling water.

The growth involved the right hand, thumb, and all the fingers, except the little finger. Because of the great swelling of the hand and fingers, the hand was useless and because of its weight the boy allowed it to hang limply by his side. The boy was in very good health at the time the injection was made. The reaction which was moderately sharp, subsided in 3 days. Ten days after the injection while playing in wet sand, he developed a sore throat. The family physician put him to bed. Four days after the attack of sore throat, the hand began to

Fig. 6. Lymphangioma of left cheek. Marked increase in growth in last two months. This tumor was not injected.

take on the clinical characteristics of a phlegmonous inflammation; repeated chills, temperature of 104° to 105°, delirium, vomiting, and the severest systemic disturbances crowded themselves into a period of 10 days, when the condition began to assume a more favorable aspect. During the inflammatory attack, because of the great swelling in the hand, the intense redness and gloss of the skin, and the sense of distinct fluctuation, it was deemed justifiable to make tension incisions. These were made. I am frank to admit that I expected to find pus, but instead of pus there exuded a thick, sticky fluid. It did not appear to me that the tension incisions benefited the condition, and it is my opinion that it would have been better if they had not been made. During the critical condition of this child, I asked permission to amputate in the middle of the forearm; however, this request was refused. After 10 stormy days, the inflammatory condition subsided, and 3 months later all incisions had healed. This was a great relief inasmuch as it is known that lymph fistulæ are very likely to form after incising a lymphangioma. Perhaps the influence of the boiling water upon the lymph was responsible in preventing the formation of fistulæ. It was 6 months before this child fully regained his health. The lymphangiomatous hand decreased about one-half in size. The thumb and one finger have also decreased but less than the hand. There is no doubt that the infection in this case was caused by the sore throat.

Inasmuch as a lymphangioma favors an inflammatory invasion upon very slight pretense, any measure for its cure or palliation, be this measure boiling water or a chemical irritant, must be instituted with great risk and with a thorough understanding of the probable clinical course the measure might excite in the tumor, fostered by a courage ample to meet any disappointment.

DIATHERMY IN SOME BONE LESIONS[1]

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THE close relation of war injuries and their sequelæ to those occurring in the industries makes the new physical treatment methods employed in their relief of especial interest at the present time. Indeed, the recent widely increased attention paid, within the profession, to such auxiliary measures doubtless follows their general application for the first time on so broad a scale to the whole range of conditions met in war hospitals. These agents are included under the general heads of hydrotherapy, thermotherapy, phototherapy, actinotherapy, electrotherapy, massage, correctional exercises and games, *vibrissage*, occupational therapy, etc.

It is, of course, agreed that it is usually, when used in suitable combinations, as an aid to efficient surgical management these physical modalities effect desired results. One hesitates, then, to set apart any single agent for exclusive comment. In army hospitals, however, so general has been the use of thermopenetration in certain wound sequelæ that a clinical discussion of its application may seem opportune. The selection of this modality is, of course, based on the well known fact that between the two active electrodes there occurs molecular friction massage, causing a definite warming of tissues with an increased arterial blood supply, an improved metabolism, and greater phagocytosis. The result is a favorable influence on the disease processes. No attempt can, however, be made at this time to draw final conclusions or even specific indications for or against its employment; the sole object of this paper is to point out results so far achieved as an incentive for further collective investigation. Using the technique to be described, or improving it, perhaps others with large clinical experience may study the subject until the definite status of diathermy in the armamentarium is assured. The following illustrative cases were taken at random from among those treated in this department. Decidedly more favorable instances might have been chosen for the purpose, but it is my desire to show average results together with obstacles often met in the course of treatment.

FRACTURE, NONUNION, OSTEOMYELITIS, DIATHERMY SUCCESSFUL

W. C., private, 27 years old, white, had been a farmer, with a clear health record before entering the army. His family, parents and one brother, are all dead from causes unknown. In battle on October 11, 1918, he was hit by shrapnel at the middle of both legs receiving a compound comminuted fracture of the right tibia and fibula and a comminuted fracture of both bones of the left leg. These were operated upon at a French hospital at once. Early in the year it was noted that osteomyelitis was present at the middle of both tibiæ; numerous healed scars were seen in the region of the left ankle where some swelling persisted. Non-union of right tibia continued. At Camp Devens, on May 14, 1919, multiple incisions were made for cellulitis of the left ankle. At this time roentgenograms of the left leg revealed a comminuted fracture of the upper third of the tibia, marked osteomyelitis; some union. Those of the right leg revealed comminuted fracture of the middle third of the tibia, marked cellulitis, and numerous sequestra evident. There is an oblique fracture in the upper third of the fibula; overriding fragments and some union is present. A large foreign body lies in the region of the upper third of the fibula. The wounds having healed by July 5, 1919, 5 days later local hyperæmia, massage, and the slow sinusoidal galvanic current were instituted to redevelop the muscles of both legs. By July 23, roentgenograms showed good position of fragments of right tibia and fibula, some destruction of bone substance of the tibia but callus present; in the left leg, good position of fragments with callus sufficient. By September 13, in the right leg, overriding in the fibula, with osteomyelitis, was noticed. Daily massage of the entire left leg was begun on October 13. The roentgenogram on November 11 showed a large amount of callus present; likewise osteomyelitis, most marked on the posterior internal surfaces. The wound is practically healed with no trace of a sinus. It was noted that there had been very little change in the past fortnight. The right leg rests in a posterior plaster half splint. The patient keeps in bed or wheel chair at all times. Although the leg is much swollen it is not inflamed,

[1] Read at Boston, April 27, 1920, before the New England Association for Physical Therapeutics.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. W. C., December 21, 1919. Right leg. Note defect in tibia; upper fragment united to fibula by bridge of callus; lower fragment shows partly loose segment.

Fig. 2. W. C., June 5, 1920. Right leg. Firm union by callus of overlapping fibular fragments, and of bridge from fibula to upper fragment of tibia. Increased areas of healthy callus cause approximation of tibial fragments; the half-centimeter of seeming hiatus probably filled with fibrous deposit.

Fig. 3. W. C., December 21, 1919. Left leg, showing bridge of callus from tibia to fibula. Areas of rarefaction in tibia and callus. Union of fragments complete.

Fig. 4. W. C., June 5, 1920. Left leg. Excess of callus absorbed. Bridge between bones permanent. Areas of rarefaction filling with normal callus. Posterolateral view showing lines of fracture (marred in printing of plate).

and the swelling has gone down a little. There is a large amount of callus present but the tibia is not united. On the front of the leg, directly over the point of nonunion, there is a small sinus from which a small amount of serous fluid discharges. The left leg has been healed for a long time so that the patient can begin bearing weight on it. Manipulation of the joints was at that time added to massage. On December 15, it was decided to apply diathermy to both limbs, a current of from 800 to 1,000 milliamperes passing from Crooke's metal "cuff" electrodes from the top of each thigh to below the knee, continuing the treatment an hour for the left limb and half an hour for the right limb. The patient was brought for treatment in a roller chair. Roentgenograms on December 21, show the lower fragment to be wide with a 2.5 centimeter separation between the lower and upper fragments. There is a suspicion of an osteomyelitic process in the upper and lower fragments. The fibula shows a complete fracture through the upper fourth with lateral displacement of 1.5 centimeters and 1/6 centimeter external overriding of the upper fragment. A small foreign body is present in the tibia and fibula. Callus bridges across from the upper fragment of the tibia to the fibula. The lower third of the tibia shows bone atrophy. It was possible on December 30, to increase the diathermy milliamperage to 1,200, even though the patient perspired at 900 milliamperes. Ionization of the scars about the left ankle was added January 10, 1920. The wound in the right leg had apparently healed by this time, so that by February 2 massage and manipulation of the right ankle became possible. Roentgenograms on February 12, anteroposterior and lateral views through right cast, showed no callus formation between fragments of tibia, but the lower end of the upper fragment is united by a bridge of callus to the shaft of the fibula. The fibula is overriding and appears united. Comparison with previous plate

showed no improvement; position unchanged. Roentgen tests on February 20 (anteroposterior and lateral views of upper and middle third of left leg) show that there is considerable callus formation throughout the fractured area with areas of rarefaction, but no sequestra are noted. There is a small piece of bone separated from the lower end of the upper fragment, lying between the tibia and the fibula. Five days later the roentgenologist notes (anteroposterior stereoscopic examination of upper third of right leg) many rarefied areas throughout the callus, but no sequestra. Anteroposterior and lateral views of the left ankle show there is marked atrophy of the bones of the ankle-joint and the tarsus. At the time of this writing, March, 1920, it may be said that pus has disappeared; there is a marked decrease in the swelling of both knees and ankles; knee flexion has greatly increased so that a brace can be substituted for the gypsum cast, shoes are now worn; and using crutches he can bear the body weight on the limbs and has started walking; finally, his discharge from the hospital is being considered.

The roentgenogram taken April 24, 1920, (lateral stereoscopic view of right leg) shows an old comminuted fracture about the middle third of the tibia. There is an area of loss of bone substance, about 6 centimeters in length, lying between the fragments which remain ununited. There is one piece of loose bone fragment about 1 centimeter in diameter, and two smaller pieces of fragment lying between the ends of the bone. There appears to be a considerable amount of newly-formed callus in this area. There is a bridge of callus, about 1 centimeter in width, projecting from the lower end of the upper fragment to the shaft of the fibula. There is shown to be an oblique fracture of the fibula in the upper third which is overlapped and united by callus. There is a metallic foreign body, one-half centimeter in diameter in the latter described area. Anteroposterior and lateral stereoscopic views of the lower third of the ankle-joint show no bone pathology other than atrophy.

The recent roentgenograms taken June 5, show the unquestioned value of diathermy in this case. In the left leg there has been absorption of excess callus while the bridge between the bones has become permanent. The areas of rarefaction have filled up with normal callus. The right leg gives similar positive evidence for thermo-penetration. Reference to the plate shows firm union of overlapping fragments of the fibula. The former hiatus of 2.5 centimeters between the tibial fragments has been diminished to scarcely 0.5 centimeter, more apparent in the roentgen plate than in the photograph made from it and here reproduced. It is probable (and this would agree with the objective clinical evidence) that this half centimeter space is filled with fibrous material so that complete bony union is in prospect. Treatment will continue with this end in view.

Another gratifying result following the use of diathermy is shown in the case of Lieut. P. D. H. Lieutentant H., 33 years old, white, with good health record for self and family, was struck by a high explosive shell fragment in battle, September 28, 1918, resulting in a compound comminuted fracture of the left femur, middle third, with loss of bone substance. The leg was operated upon 12 hours later, and a Thomas splint applied. Primary union of wound followed. As the bone fragments did not unite, on January 9, 1919, the thigh was encased in a gypsum cast. It became necessary to insert a bone graft on March 6, and a good result was reported. Roentgenograms taken in the spring of 1919 showed full union and no sequestration; later, the presence of several minute foreign bodies was noticed. On September 15, mention is made of ankylosis of the left knee and ankle, with only a limited range of motion. Physical measures, begun October 22, and practiced daily, included whirlpool bath of leg and thigh, massage of soft structures, manipulation of both affected joints, and the application of the galvanic, slow, sinusoidal current to wasted muscle groups. Roentgenograms on December 3 showed an abundance of callus but also a worm-eaten appearance of both upper and lower femoral fragments; the bone graft, 17 centimeters long, had not been absorbed. This finding was a suggestive indication for diathermy, which was applied here on December 19, 20, 29, 30, 31, 1919, and January 2 and 6, 1920. These seven treatments it was hoped might prove sufficient to stimulate osteoblastic action, a return to normal local nutrition and increased phagocytosis to remove any remaining infective process. To encourage further improvement excision of the small defective area on the lower tibial fragment and the sinus leading therefrom was done on January 9. Complete laceration of the left sciatic nerve had occurred at the time of the original shell wound, and on January 9, 1920, high suture of the nerve was performed. The accompanying paralysis had included all muscles on the back of thigh and leg. At the time of this writing, March, 1920, general return to nerve function has scarcely been possible; some recovery of action in the hamstrings may, however, be reported, that of the biceps being strongest. Of equal significance is the marked redevelopment of the other soft structures and of partially restored function in the joints of the affected extremity. As for the damaged osseous tissues, by March 15 the X-ray findings (anteroposterior and lateral views of right femur) showed the bone graft *in situ* with abundant callus formation. The bone graft had united at both ends and had blended with the femoral fragments, giving a healthy appearance throughout. Outside of the graft area there is ample callus, throughout a large extent of which the appearance is healthy. The worm-eaten area on the upper femoral fragment and the like area on the lower fragment previously mentioned, while unchanged, seem to hold minute sequestra and not foreign bodies, as formerly believed. Forcible manipulation of the fibrosed knee had by this time greatly increased the range of joint action, but, unfortunately,

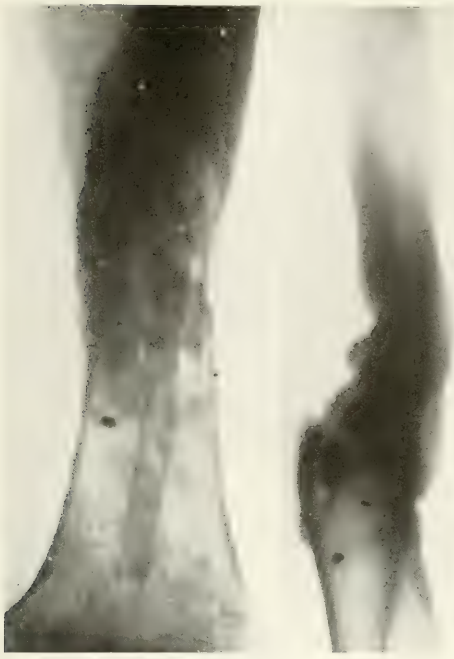

Fig. 5

Fig. 6.

Fig. 7.

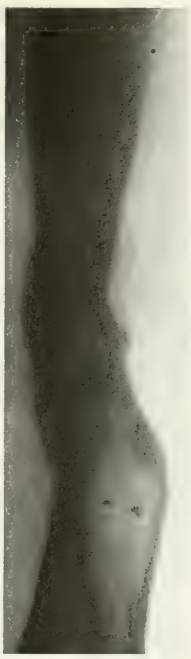

Fig. 8.

Fig. 5. Lieut. P. D. H., December 3, 1919. Left femur, anteroposterior view. Loss of bone substance; defects in both fragments. Bone graft united at upper end; displaced below.

Fig. 6. Lieut. P. D. H., December 3, 1919. Lateral view of left femur at outset of diathermy. Note displacement of fragments in relation to bone inlay.

Fig. 7. Lieut. P. D. H., June 22, 1920. Left femur; callus healthy; rarefied areas filled with healthy callus. Union of fragments firm. Anteroposterior view.

Fig. 8 Lieut. P. D. H., June 22, 1920. Left femur, lateral view. Rarefied areas now filled with normal callus. No rarefaction about the two foreign bodies present. No sequestra. Union complete and firm.

caused much relaxation of the lateral ligaments with wabbling of the left leg when walking. It was therefore decided to apply a caliper splint and omit the physiotherapy treatment for the present. Roentgenograms, lateral and anteroposterior, taken June 22, 1920, show the callus to have a much healthier appearance while the rarefied areas seen in previous plates have become filled with healthy callus. There are two metallic foreign bodies present about which there is no rarefaction. There is no evidence of sequestra. Union of fragments appears to be complete and firm.

Altogether the use of diathermy in this typical bone case has been most encouraging and points the way to improved methods in the treatment of delayed union in bone fractures in general.

OSSEOUS NON-UNION AND OSTEOMYELITIS ONLY PARTLY AIDED BY DIATHERMY

B. J. O'N., private, age 28, white, formerly a motorman, never ill except from scarlatina 3 years before entering the army. Parents, brothers and sisters are all living and well. A gunshot wound of the right leg, received in action, September 27, 1918, caused a compound comminuted fracture of the tibia with drop-foot, the latter probably due to injury to the anterior tibial nerve. Roentgenograms on February 14, 1919, showed a compound transverse fracture of the middle third of the tibia with complete loss of 3 inches of the shaft. The fragments were in good alignment but little callus had formed. Twelve minute foreign bodies were apparent in the soft parts of this region. Four days later a splint had been applied to the leg and foot. Massage of the leg was started on March 27. A bone graft operation to fill a 5.5 centimeter defect, was done May 14, the gypsum cast being opened 6 days later. Roentgenograms taken June 7, showed that the lower end of the bone graft had slipped out of the lower fragment and pointed posteriorly about 1.5 centimeters. On June 24, therefore, the bone graft was replaced. It had been deflected by a sharp point of bone at the lower end of the upper fragment of the tibia. Roentgenograms on July 14, revealed apparent callus union between the upper fragment and the upper end of the bone graft, while those of July 19 showed that the lower end of the bone

Fig. 9. Fig. 10.

Fig. 9. B. J. O'N., November 14, 1919. Right tibia, anteroposterior and postero-anterior views. Loss of osseous continuity; bone inlay displaced at lower end; no callus there; upper end slightly absorbed.

Fig. 10. B. J. O'N., March 31, 1920. Bone graft attached to upper fragment of right tibia; loose below. Line of fibrous callus distinct between upper and lower tibial fragments.

graft had slipped out of the lower fragment of the tibia, and that there were two small fractures of the upper portion of the lower fragment of the tibia. There is a 1 centimeter backward displacement of the lower end of the bone graft. Four days later an operative attempt was made to replace the graft. Then, to improve local metabolism, beginning on August 6, daily whirlpool baths and massage were given, avoiding the site of the graft and fracture. Roentgenograms on August 13, showed the lower end of the bone graft to be displaced backward as it was approximately 1.5 centimeters behind and above the lower fragment. There was then a slight amount of callus formation but as yet no callus union. An operation by the Chutro method, on August 20, provided a bone implant including periosteum and a thin layer of cortex. The X-ray findings on September 5 showed a loss of bone substance of about 2.5 inches at the site of the fracture, with bridging across the graft by callus. By September 19 the wound had closed. Two days previously daily massage of the anterior surface of the leg was again begun along with vibration by the soft rubber cup vibratode. The X-ray on October 18, showed areas of rarefaction around the bone graft, the latter not being absorbed. Examination had to be made through the gypsum cast. This cast was still in place November 1. Another one was applied on the 13th from the knee to the toes. The following day an X-ray examination made plain that the bone graft in its lower portion had been broken off. No callus had formed in the lower fragment. The upper end of the graft showed slight absorption. Several fragments of bone were lying between the upper and lower fragments, which were separated by 6 centimeters. These fragments appear to act as a sequestrum. Finally on November 16, daily diathermy was instituted, from 300 to 500 milliamperes being applied for from 1 to 1.5 hours. As the feet were in a cast, the lower electrode had to be slipped inside and against the sole. At this time also ionization of the large scar which was generally adherent to the site of the incision, was proposed, but because of the marked sensitiveness of the surface, this method of treatment could not be used. On December 22 an X-ray examination made through the cast, showed several fragments of bone adjacent to the graft, but the observer was unable to determine whether they were parts of the graft. The lower end of the graft was broken; no callus was present. There was marked atrophy of the lower fragment of the tibia. After a furlough of 20 days, daily diathermy was resumed on January 15, 1920. The next roentgenogram, on February 14 (anteroposterior and lateral views), showed the upper end of the graft apparently solid but the lower end detached and pointing backward; there was a slight amount of callus formation; no evidence was found of osteomyelitis. On the 16th, another bonegraft operation was performed. Throughout the operative field many adventitious blood vessels were found, in the surgeons' opinion complicating the procedure. These new vessels, or rather enlargement of smaller ones, were probably an outcome of the diathermy treatment, an objection to be carefully considered under certain conditions. This excess of new vessels could have been readily controlled had ionization followed each diathermy treatment; indeed, just prior to this operation ionization of the adherent scar had again been suggested but lack of time, because need for operation seemed imperative, did not permit of its being used. By the 23d the wound was discharging and the next day sloughing, with a large sinus down to and exposing the tibia. By the end of March the operation wound now only 1 inch by ½ inch, was fast closing, as granulations were profuse. According to the roentgenograms the bone graft had united at the proximal end although not yet to the distal fragment. Roentgenogram on March 31, anteroposterior view, showed an old comminuted fracture of the middle third of the right tibia. There was an area of about 10 centimeters showing marked loss in bone substance. Projecting downward and backward from the upper fragment there was a long strip of callus about 8 centimeters in length and 2 centimeters in width. Projecting upward from the lower fragment, there was a slender strip of calcified periosteum about 4 centimeters in length. Anterior to the two areas described above there was seen a bone graft, about 17 centimeters in length, which appears to be well

united above, in which position it gave a healthy appearance and appeared to fuse well. The lower end of this graft was surrounded by some absorption and remained united. About the center of this graft, in which location it appeared to be entirely absorbed, there were seen two very dense strips of callus the health of which was doubtful, their density being almost too great for normal bone. At the end of April skin grafting was in prospect to cover the bared area in the soft tissues over the middle of the bone graft. The advisability of further resort to diathermy was also under discussion, although heavy felt wedges between the gypsum cast and his hammer-toes might temporarily prevent application of the lower electrode. As the bone graft did not unite, it was removed in June, after which the wound soon closed. A long strip of fibrous callus now, June 21, 1920, unites the ends of the bone, and a gypsum cast has been applied to the limb for its protection. It was because of this cast that diathermy had to be temporarily discontinued. Previous to the use of diathermy bone grafts had failed to induce any deposit of callus in the ends of the fragments; the presence of callus did, however, become evident after insertion of the present inlay so that it was natural to infer that diathermy was the causative agent. We expect that firm bony union will consequently take place after a longer or shorter period, varying from 6 months to 1 year.

In this case it was again proved that a decided addition to the circulation could be depended on by the application of diathermy even though local conditions, possibly the peculiar nature of the infection, had until the application of diathermy interfered with deposit of callus, etc.

J. B., private, age 29, white, formerly a stock clerk, has a clear health record. His mother, brother and 2 sisters, the sole relatives, are living and well; his father died from tuberculosis at the age of 47 years, the only case in the family. On July 19, 1918, he received a shell wound with a compound comminuted fracture of the upper third of the right humerus. First aid was given 10 hours later, and on July 24, a more complete operation was done. Because of a secondary hæmorrhage on August 13 another operation was done and the artery ligated. Hæmorrhages recurred on August 20. On September 10 a shell fragment was removed. Returning from France on January 15, 1919, the patient was operated on at Camp Dix the operation consisting of curettage of the necrosed bone. The wound healed about March 15 but reopened May 24. Physiotherapy was instituted April 2: daily applications of radiant light and heat, massage and interrupted galvanism were used to restore the wasted soft structures. One week after reopening the wound, May 31, the diagnosis, mentioning fracture, included osteomyelitis and sinus formation; large scars on the anterior surface of the right shoulder and side of

Fig. 11 (at left). J. B., September 3, 1919. Right humerus; bone defect; partial failure at union of graft.

Fig. 12. J. B., June 15, 1920. Partial ankylosis of shoulder. Partial union at site of fracture; increased callus.

chest, in the axillary region; motion of the arm limited in all directions by rigidity of the joint and weakness of the muscles of the arm; no nerve involvement. At this time pain had disappeared from the right upper extremity. The X-ray findings, on June 3, were of fair union by callus with slight deformity, no definite evidence of osteomyelitis; then on July 14, apparently firm union by callus, in fair position, with a wedge-shaped loss of bony substance on the outer half of the shaft of the humerus. Again, August 6, there was no change in condition, but at the upper end of the lower fragment there was a beginning rarefaction of the bone which may have been the result of trophic change or of an osteomyelitis, probably the latter. Two days later, radical effacement of the sinus in the right humerus was done. On August 21, as the scar of the incision had broken down, it was dressed with Dakin's solution and tubes inserted; then, on August 28, the sinus was curetted under novocaine. Daily use of radiant light and heat with massage of elbow and hand were again started September 2. X-ray examination, the next day, showed apparently firm but incomplete union but no evidence of osteomyelitis or sequestra. To obtain more direct action, radiant light and heat was on the following days changed to diathermy, but because of pain caused in the affected area, possibly due to nerve congestion or some other acute process induced, this change was at once reversed. The sinus was opened on September 18 and a small fragment of

Fig. 13 (at left). M. C., August 22, 1919. Angulation of fragments of fractured femur, the lower fragment overriding externally and laterally; loss of bone substance. Diathermy treatment began December 12, 1919.

Fig. 14. M. C., June 23, 1920. Excess of callus has disappeared. A very small sequestrum is noted; its removal promises complete closure of wound. Osteomyelitis absent.

bone removed; consequently massage of the limb had to be omitted. By the 22d, however, it was again possible to apply diathermy. The X-ray report, 2 days later, was of some loss of bone substance but also of union by callus apparently about 1 centimeter in width at its smallest diameter; position of fragments fair. By the 26th, massage and joint manipulation could be added. Unfortunately, on October 3, while trying to mount an automobile, the patient bore down on his right hand, and the right arm began to pain. X-ray examination showed a fresh fracture through the callus at the site of the old fracture in the surgical neck of the humerus, but with the fragments in good position. This complication, of course, made the application of a gypsum cast necessary. Roentgenograms on November 7 showed but a very slight amount of callus present. The upper fragment points downward, inward, and somewhat backward, forming an angulation with the lower fragment which tapers and bows upward and inward and comes in approximate contact with the upper fragment. The head of the humerus shows bone atrophy and is displaced somewhat upward. The X-ray report of January 24, 1920, showed much improvement, there being more callus, no evidence of an active osteomyelitic process and less bone atrophy. The callus did not appear to be strong enough to permit of much manipulation. Three days later diathermy could once again be started, his ward officers hoping that it might remove pus and so avoid another operation. (There had been a tendency to pus formation in various areas but when discharging at this site there would be no pus elsewhere.) A graded plan of applicaton was resorted to, the first 2 days calling for 300 miliamperes for 10 minutes each; then, for 2 days 600 milliamperes for 20 minutes each; next 800 milliamperes for 20 minutes for each of 2 days; finally these figures for 20 minute periods were reversed on the succeeding 3 days. After the first 3 days the excessive flow of pus had diminished; within 2 weeks the pus had altogether disappeared. Then light massage with careful manipulation was added. Soon he was ready for discharge. At this time while riding in a motor bus, it careened heavily on meeting an obstruction, the patient was hurled across the interior of the car, once again fracturing the arm. The broken arm is at present in a splint which permits the use of diathermy (from 500 to 700 milliamperes for 40 minute periods) and the absence of pus is thus assured. Bristow stimulation of the defective muscles was added on March 4. Stereoscopic roentgenograms taken April 24 show increased callus at the site of fracture, even though the bone will not yet stand much manipulation.

M. C., age 28, had the usual diseases of childhood and repeated attacks of tonsillitis in 1911; had otherwise been healthy. His father died from nephritis and his mother from "complications." On October 6, 1918, in France, a revolver bullet penetrated the right thigh, entering on the anteromesial aspect about 3 inches above the knee-joint and emerging posterolaterally about 10 inches above the knee, and causing a compound, comminuted fracture of the femur. He was treated at various hospitals abroad and in the United States; reaching Fox Hills, there was found 15 degrees of motion at the knee, with considerable atrophy in the structures below. Curettage and sequestrotomy with drainage was done at this hospital on April 23, 1919; probable good union was reported, on X-ray examination by May 25. On June 20 his general condition and special senses were found normal as, also was his weight, 162 pounds. Four days later the X-ray findings showed an oblique fracture of the right femur, united by callus, with an area of bone absorption in the center of the region, and osteomyelitis of the ends of the fragments. The posterior fragment was displaced backward. There was a discharging sinus. Laboratory tests showed the presence of staphylococci both in smear and in culture and on July 2, of bacillus pyocyaneous. The sinus was operated on July 8, the wound being closed by the Babcock method. Roentgenograms on August 22 showed one large and three small areas of absence of bone in the region of fracture. In the larger area is a foreign body ½ centimeter long and three adjacent minute foreign bodies. There are five or six small foreign bodies in the bone itself. There is evidence of apparently firm union by callus. By November 1, it was decided to give physiotherapy treatments. Diathermy proved not well borne at first, the skin being too tender; so

radiant light and heat was therefore substituted. Massage, mild joint manipulation, the slow galvanic sinusoidal current to the wasted muscles, and ionization of scar tissue proved the best daily treatment. The X-ray findings on November 14 mentioned overriding with the lower fragment pointed externally, causing angulation laterally. There were several holes through the lower portion of the upper fragment showing loss of bone substance in the anteroposterior view. It became necessary on December 3, because of the circumscribed dermatitis, to omit all physiotherapy except massage to the lower part of the leg. On December 12 daily use of ultraviolet ray to the ulcerated area was started, and the following day diathermy of the leg was added. For the latter treatment a wide, flexible metal cuff encircled the thigh above the knee, the foot resting in a warm water bath holding the other metal electrode. It was because of recurring furuncles on the face and neck that the presence of osteomyelitis was suspected. To remove this tendency to pus formation a diathermy volume of 600 to 700 milliamperes was promptly given for 2 hours. Within 10 hours there occurred a focussing of symptoms on the front of the thigh, with free discharge of pus. Since then there have been no furuncles anywhere. Daily forty-minute applications of diathermy are given for the osteomyelitis but no pus is flowing, only a simple serous fluid being present. Only when he is unavoidably absent for some days from treatment is a little pus to be found. The X-ray findings by March 3, 1920, merely mention that there now appears to be a minute sequestrum in the callus and that there remains but one small hole through the bone at the lower end of the upper fragment. Under local anæsthesia immediately afterward the small sequestrum was removed and the sinus curetted so that by March 9 he was able to leave on furlough. As this operation did not prove sufficient, on March 30 a more complete removal was done under full gas and oxygen anæsthesia. This operation included excision of the scar and sinus together with effacement of diseased bone at this site. At this writing, April 25, good progress can be reported, the patient having again become ambulant. Attention is called to the prompt action of diathermy in changing the secretion of pus to one of thin serous flow, a favorable change often to be noted in this way.

In such cases certain facts as to this valuable current should be thoroughly grasped by the operator to ensure its accurate employment. One must be sure that the apparatus employed is really scientifically constructed so as to produce genuine resonance between its component parts as, otherwise, the absolutely necessary quality of d'Arsonval current is not obtained. Then, while in operation, one must frequently note the tone of the latter so as to avoid its shifting to a thermofaradic or an irregularly interrupted high frequency current that might prove irritating instead of soothing, which is of importance where pain is a factor in a case. Again, where newly formed callus is to be acted on by diathermy, as after bone inlays or for ununited fracture, it is well to recall that applications of excessively high amperage (even if not of too great volume, but when too frequently repeated) may have an actual destructive action on recent callus. Indeed, such frequently applied high amperage diathermy is distinctly indicated where the deposit of callus becomes so bulky as to interfere with normal function. It is in this way that new bone formation may usually be directly controlled.

The hitherto unfavorable results from accepted treatment methods noted in the intractable conditions just described call for research study along altogether newer lines of inquiry, and it is expected that in so rational a modality as diathermy the answer may be found. Based on the now undisputed fact that diathermy brings about a marked enlargement locally of existing blood vessels, if not also an actual growth in their number, and judging from the cases just quoted, it is reasonable to anticipate more or less increase of bone deposit for cases of delayed union or bone graft; removal of osteomyelitis, where present; cessation of infection, and closure of the cavity by granulation. It is to confirm these important suggested changes that further efforts should be directed, and members of this association are peculiarly qualified to pursue such an inquiry. An intensive collective investigation of the kind should be carried out on a large scale, where possible, in military, railway, and other hospitals receiving many accident cases from the industries.

It is asked, finally, that research workers may describe full details of technique employed, for only by a carefully thought out technique can future observers repeat the successes here obtained, in treatment of these obstinate complications.

The writer wishes to express his obligation to colleagues on the hospital staff who aided in this study by contributing data, illustrations, and helpful criticism.

BILATERAL RENAL DYSTOPIA

By H. W. E. WALTHER, M.D., F.A.C.S., New Orleans

RENAL dystopia is a condition in which the kidney occupies a faulty position due to a congenital anomaly. Therefore, it differs from the movable, wandering, or floating kidney in that it never has occupied its normal position. Cases of unilateral pelvic kidney are met with not infrequently, but instances of bilateral renal dystopia are relatively rare. Bryan (6), in 1915, after a most circumspective search of the literature, could find but 18 authentic case reports. The condition has been considered by many of little importance clinically. However, under certain conditions, as for example, pregnancy, where nephritis or even uræmia impend, grave sequelæ may ensue should the true condition go unrecognized. The exhaustive investigations which have been made by Plummer (16) regarding this most interesting congenital defect have aided to no small degree in making the condition more comprehensible.

Etiology. Two theories have been advanced as regards the causation of this condition. They will be enumerated briefly.

Bryan (6) states that in early life the cloaca is both the future rectum and bladder. A vertical fold separates the bladder anteriorly from the rectum posteriorly. The wolffian duct gains the cloaca dorsally and ultimately forms the renal pelvis and ureter. The kidney slowly ascends to the lumbar region, in the process of fœtal evolution and development, receiving in its excursion arterial twigs which are given off from successively higher points on the aorta; as the kidney reaches higher, these twigs atrophy, drop off, and new arteries supplant them. The artery which continues as the renal artery is the last stem claimed by the kidney. If, in its forced excursion upward, one stem refuses to give up its nutritive right, the kidney is tethered, and with development and embryological growth the artery thickens and becomes permanent, fascial increase is noted, and the kidney is anchored in moorings which nature has not intended.

The studies of Hill (10), Pohlman (20), and Strater (21) tend to show that the kidney may be arrested at any point in its process of ascent and rotation independent of its blood supply. They argue that as no vascularization of the kidney occurs until it has reached its permanent position, it therefore follows that in this type of renal anomaly the kidney vessels must originate from the nearest arterial trunk, in a direct course to that organ. They found that in some instances the kidney, in the process of its embryonal wandering, passes over the course of several arteries and may, during this time, be supplied by several vessels. Arrested in the pelvis, these temporary vessels then become permanent ones. They therefore reason that an abnormal vascularization is not the cause of dystopia of the kidney but that just the opposite is true, that is, that the kidney abnormally placed seeks the nearest blood supply.

Anatomy. The dystopic kidney is generally found normal in size, although Plummer describes a specimen in his collection as being considerably smaller than normal. It is the exception to find this type of kidney normal in shape as has been particularly emphasized by Morris (26). The renal pelvis is always misshapen. These variations are commonly due to the organ resting upon the promontory of the sacrum, the sacro-iliac joint, or the linea innominata, in consequence of which depressions may be found on the posterior surface of the organ. Fœtal lobulations are occasionally seen.

The vascular supply in these cases is interesting. Meyer (13) reports two or more arteries and veins leading to dystopic kidneys he has studied. Anitschkow (2) describes a case in which the kidney was supplied with five arteries. The artery, in these cases, arises from the lower portion of the aorta, at the bifurcation or just above this point. In other cases reported, the arterial supply has arisen from the common iliac, hypogastric, median sacral, and external iliac. This origin

of the vessels in itself is sufficient evidence to distinguish a congenital renal misplacement from a movable kidney.

The renal veins empty at points corresponding to the origin of the arteries. A portion of the embryonal cardinal vein may assist in the formation of the renal vein.

The ureter may be found shorter than normal but not necessarily is this always true, as in the author's case both ureters were found to be of normal length.

Relative to location, some dystopic kidneys may be found entirely within the small pelvis, behind the uterus or partly behind the bladder. Others are found high up in the iliac fossa to the side of the vertebral column, or in front of the vertebral column. Dorland (27) reports an instance where the kidney was found in a pocket of parietal peritoneum. The misplaced organ is usually to be found upon the side it rightly belongs, but it must not be forgotten that crossed-kidneys and ureters may exist. Fused kidneys may be present in dystopia; Cathelin found only 5 out of 19 where fusion was absent; Mennacher, 9 cases; Dorland, 4 cases.

The organ in these cases is retroperitoneal; it may be found partially between the layers of the mesosigmoid or partially within the broad ligament. According to Strater (21), the adrenals are always found in their normal position, while Morris states that he found the adrenals displaced in 9 out of 20 cases observed.

Congenital defects in other parts of the body are not uncommon in conditions of dystopic kidney. Abnormalities in the genital organs of both sexes, of the bladder and rectum have been reported. Unicorn uterus; bicorn uterus; double uterus; uterus and one tube absent; upper part of the vagina and inner portions of the tubes absent; uterus and vagina absent; testicle atrophic and located in the inguinal canal; one-half of bladder partially undeveloped; one-half of bladder absent; atresia ani; epispadias; hypospadias; exstrophy of bladder; cryptorchism;—these are some of the anomalies enumerated in the literature.

Pathology. The misplaced kidney need not necessarily be abnormal in structure. Its abnormal condition, however, predisposes the organ to pathological conditions. Hydronephrosis and pyonephrosis are quite frequently met with. Strater (21) found 12 cases of hydronephrosis and 6 cases of pyonephrosis in a total of 27. Calculus, sarcoma, tuberculosis, and cystic degeneration have been reported. In the author's case there was a bilateral hydropyonephrosis, each renal pelvis having a capacity of 70 cubic centimeters, the infective organisms being cocci and bacilli.

A résumé of the necropsy findings in 18 authentic cases of bilateral renal dystopia collected by Bryan (6) shows the following constant development inhibition: (a) kidney fixed, densely bound down, flattened; (b) pelvis usually situated anteriorly; (c) located about sacro-iliac synchondrosis, i.e., below the pelvic brim; (d) one small single artery, may be as many as six twigs, entering at an abnormal site; (e) veins multiple, much enlarged, emerging at an angle; (f) adrenal bodies in their normal subdiaphragmatic locations; (g) lobulation of the kidney; (h) hypoplasia of the calyces; and (i) ureters are standard, but shorter.

Symptomatology. While it has been found at autopsy that renal dystopia is equally frequent in both sexes, Strater, in his 67 clinical cases, found normal kidneys 42 times in women and 4 times in men. As Plummer rightly concludes, this can be accounted for partly because of the fact that a kidney located in the small pelvis is more prone to give symptoms in woman than in man and because of the greater frequency of pelvic examinations and pelvic operations in women, these leading to the discovery of the abnormally placed kidney.

Pain in the lower mid-back, abdomen, loins, buttocks, radiating at times into the lower limbs; a feeling of weight in the abdomen, all of which may be aggravated at the menstrual period. Pain at coitus has been noted. Disturbances of menstruation may occasionally occur. Pressure on the rectum frequently causes constipation. Chavannez's case of left hydronephrotic kidney, lying between the leaves of the mesocolon, led to a pre-operative diagnosis of carcinoma of the

sigmoid. Enuresis and tenesmus occur. Psychic disturbances play no little part in some of these cases. Other pelvic organs may be displaced. The condition has been known to precipitate abortion during pregnancy.

The symptoms in some of these cases may be very misleading. At best, the history-record, in which subjective symptoms are enumerated, can only be considered as one link in the chain of almost endless possibilities.

Diagnosis. Only by routine abdominal examinations, carefully executed, can one hope to discover existing anomalies. Where the patient is slender bimanual palpation can be carried out with a fair amount of precision. Obviously in obese individuals, the examination will not be as satisfactory. In all tumors about the brim of the pelvis, particularly in those instances where the kidney cannot be felt in its normal bed, renal dystopia should be borne in mind.

Vaginal palpation in the female is of great value. In the male we resort to rectal palpation.

One must ever remember that the finding of both kidneys in their normal positions does not necessarily exclude the possibility of a dystopic supernumerary kidney, as has been reported by McArthur (14).

Urinalysis shows no abnormalities that are endogenous to the condition. Functional tests, such as phenolsulphonephthalein, which give us the secretory capacity of the kidney, when linked with chemical studies of the blood for urea nitrogen, non-protein nitrogen, uric acid, and creatinine, will give us information of inestimable value.

It is the cystoscope and the radiographic ureteral catheter, however, which are of the most value in determining the presence or absence of congenital pelvic kidney. By performing cystoscopy, introducing opaque catheters into the ureters up to kidney pelves, injecting an opaque fluid through the catheter into the renal pelvis and then taking a roentgenogram, we can locate, with a definiteness not obtainable by any other means, the route of the ureter, and the size, shape, and position of the kidney pelvis. To this procedure the name of pyelography has been given. As the value of this diagnostic aid becomes more widely appreciated, we will hear of more cases of renal dystopia being detected.

Treatment. As this contribution deals primarily with bilateral renal dystopia, there is little to be said as regards treatment when considered from the surgical aspect. Even in unilateral dystopia, in deciding upon a proper course to pursue, one must consider separately the cases where the kidney is normal in structure, and those where a pathological condition exists. It is obvious that where a kidney is found abnormally situated but is normal in structure and function, and where no serious symptoms warrant interference, it is best left alone. On the other hand, should acute infection be present in a kidney of this type, either hæmatogenous, lymphogenous or urogenous, where the simpler procedures such as lavage of the kidney pelvis and catheter drainage fail to produce the desired relief of symptoms, then nephrectomy of offending organ should be seriously considered. The feasibility of such an undertaking would naturally hinge upon the functional capacity of the other kidney in determining whether or not the remaining organ can fittingly sustain the life in the patient.

Transplantation of dystopic kidneys has been attempted from time to time, but with little success. Munro (28) states that in a number of cases in which the kidney was transplanted, nephrectomy was required later on. The difficulty accompanying such a transplantation, particularly where infection is present, is apparent.

L. T. McD., white male, single, age 23 years, native of Mississippi, a saw-mill hand by occupation, presented himself at the Out-Patient Dispensary, Charity Hospital, on August 12, 1915.

Complaint. Frequency and burning at each urination; the voiding of cloudy, shreddy urine; pains in loins; and occasionally febrile attacks.

Family history. Mother, father, and one sister dead—causes unknown. Has 1 brother and 3 sisters living and well. The family history is negative for tuberculosis, cancer or hæmophilia.

Past history. Patient had measles, typhoid, malaria, and erysipelas. Denies mumps. Has never been operated upon. Has had no instrumentation. His appetite has always been good. Sleeps only

fairly well at nights because he must get up so often to void urine. Bowels regular. Average weight 125 pounds; has lost 10 pounds in past 12 months. Does not use tobacco, narcotics, nor alcohol.

Venereal history. Denies all venereal diseases.

Present illness. For the past three years patient states that he has had "kidney trouble." He has been under the care of a doctor all this time. His trouble started by a marked increase in the number of urinations daily as well as having to get up frequently at night to void. $\frac{N\ 15 - 20x}{D\ 15 - 25x}$

Of late he has noted that he passes large quantities of cloudy urine containing many clumps of pus. He also now complained of occasional, severe pains in abdomen, loins, and sides—these pains frequently radiating down into lower limbs. Attacks of fever at intervals he attributes to malaria. Has never urinated bloody urine nor has he passed any gravel. For past year and a half he has suffered with ardor urinæ.

(At a later date, upon careful inquiry, I was able to bring out the interesting fact that *since childhood* the patient had had urinary frequency and always voided large quantities of urine.)

Physical examination. Heart, lungs, abdomen, extremities, glandular system, and external genitals negative. The patient was a thin subject, would relax his abdominal muscles perfectly, and it was easy to palpate the abdomen for abnormalities. Examination, repeated on many occasions, was negative. The kidneys were not palpated, neither was there tenderness over either kidney region. Systolic blood-pressure 115 millimeters mercury by Tycos. Temperature, normal. Hæmoglobin 75 per cent, by Tallquist. Reflexes were studied by the late M. J. de Mahy, neurologist, who reported as follows: patellas absent, no Romberg, no Babinski, no klonus, right pupil reacts to light and accommodation, left pupil fixed. General muscular development good; function good. Head is box-shaped; circumference 54 centimeters; anteroposterior diameter 26 centimeters; lateral, 33 centimeters from horizontal portion of zygomas. According to Binet-Simon test the patient was found by Dr. de Mahy to have the mentality of a child of 12 years. The eyes were reported by J. B. Larose, ophthalmologist, as follows: right 20/xx; left 20/xx. Left pupil slightly contracted (about 3 millimeters) no reaction to light or accommodation. Fundus normal in both eyes; media normal.

Prostate was normal in size, shape, and consistency; seminal vesicles not palpable. Secretion from prostate and vesicles was found normal at microscopy.

Urine. First glass very cloudy with many clumps of yellowish material; second glass very cloudy with many clumps of the same material. Upon examination of a portion of the second glass of urine, we found the specimen to be pale, water white in color, acid, specific gravity of 1005, trace of albumin, no sugar, no crystals, no casts, a few

Fig. 1. Exposure made to include more of the bony pelvis. Showing catheters in both ureters, pyelograms demonstrating double pelvic kidneys and the beak of the cystoscope in bladder.

epithelial cells, a few red blood cells, and many Gram-negative bacilli and Gram-positive cocci.

Wassermann and Tschernogubow reactions reported negative by H. W. Wade.

Phenolsulphonephthalein test, 1 cubic centimeter intramuscularly, gave, for the two-hour collection, 900 cubic centimeters of urine with a total reading of 15 per cent. Within a week a second phthalein test gave 550 cubic centimeters of urine with 16 per cent of dye for 2 hours.

Cystoscopy. A No. 24 F. double catheterizing cystoscope was introduced into bladder without difficulty. Before instrument was passed the patient had been requested to void and empty the viscus. Immediately after entering bladder with cystoscope, urine to the extent of 300 cubic centimeters was drawn off (residual). The entire vesical mucosa was found of a dull, dark red appearance, more marked on trigone. Everywhere one noted flakes of pus and mucus—a typical picture of chronic cystitis. Trabeculations were present over entire bladder surface, the muscle bands standing out so prominently in places as to make the depressions appear as small diverticula. In the vertex, the true opening of a diverticulum, about the size of a silver ten-cent piece, was seen. Upon passing a catheter into the opening of the diverticulum it was found to be about 2 inches deep. There was no intravesical projection of the prostatic lobes. Both ureteral ostia were markedly congested but were normal in

size, shape and function. No. 6 F. ureteral catheters were inserted into ureters up to kidney pelves, no obstruction being met with on either side; right ureter taking 45 centimeters of the catheter while the left ureter accommodated 48 centimeters. It was noted that immediately urine began to flow with rapidity from each catheter, both 10 cubic centimeter test tubes being filled in about 3 minutes. The urine was very pale in color on both sides. Upon aspiration, 50 cubic centimeters of pale urine was drawn off from each kidney pelvis. Urine from right kidney showed: trace of albumin, no sugar, many epithelial cells, few red blood cells, few pus cells, many gram negative bacilli, few gram positive cocci, no casts; from left kidney: trace of albumin, no sugar, many epithelial cells, few red blood cells, no pus cells, many gram negative bacilli, many gram positive cocci, no casts.

Both kidney pelves were lavaged at cystoscopy with a 1 per cent solution of silver nitrate.

Cystoscopy was repeated a week later with ureteral catheterization. Urine from both kidneys was found sterile at this time, both microscopically and to culture. By the use of 2 per cent sterile boracic acid solution it was found that the capacity of each kidney pelvis was 70 cubic centimeters. The bladder capacity was determined as being 400 cubic centimeters.

The patient was admitted to one of the genito-urinary wards at the Charity Hospital for further study. It was considered by the writer that the patient had a bilateral hydronephrosis and that pyelography should be carried out in order to determine the shape and position of the pelves. Furthermore it was considered advisable, if possible, to relieve the obstruction at the vesical neck which was causing so large a residual. As paresis of the detrusors or cerebro-spinal lesion had been eliminated by the neurologist seeing the case, some other cause for the vesical retention was evident.

Due to the fact that the large amount of residual urine in the bladder was undoubtedly causing back pressure on the kidneys, an indwelling urethral catheter was inserted into the urethra, fixed, and the patient put to bed. Pulse, temperature, respirations, all normal. Urinary output, studied for one week, averaged 4,500 cubic centimeters daily.

With the able co-operation of Adolph Henriques, radiologist, pyelograms were made on the case, the opaque medium being 10 per cent collargol. Fifty cubic centimeters of this opaque solution was permitted to flow, by gravity, into each kidney pelvis, the author's apparatus being used.

Figure 1 includes most of the bony pelvis, and shows the radiographic catheters, the pyelograms of the bilateral pelvic kidneys and the beak of the cystoscope.

Comment. It is obvious that without the aid of the X-ray this diagnosis could not have been made. For besides demonstrating the position and shape of the kidneys in this most interesting case it explains why the patient had vesical retention of urine. The pressure of these pelvic kidneys, encroaching as they do, on the vesical outlet, played the same rôle as might two large, lateral prostatic lobes.

Patient remained in hospital only two weeks and then deserted. Operative interference was never considered while the case was under observation. Because of the fact that the condition was bilateral, and with the low functional output it was considered best to treat the patient symptomatically. He would have refused any surgical aid had it been offered. He had so expressed himself.

The patient was lost sight of for nearly a year. Nine months after last seeing him in the Charity Hospital, he called at the office of the writer to report that he was "feeling fine." He complained of no pain whatever. The urine was again badly infected, however. He refused cystoscopy. A phenolsulphonephthalein test was done and in 2 hours he excreted 455 cubic centimeters of urine with 8 per cent of phthalein. Residual of 360 cubic centimeters. He was given bladder irrigations for a few days and again deserted. Although efforts have been made to correspond with patient and his relatives, nothing more has been heard of the case.

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DEPARTMENT OF TECHNIQUE

THE TREATMENT OF SUPPURATING WOUNDS FOLLOWING ABDOMINAL SECTION[1]

By THOMAS J. WATKINS, M.D., F.A.C.S., Chicago

SUPPURATION of wounds should not occur in clean cases. When it is necessary to operate upon an "acute abdomen" a considerable percentage of the wounds will be infected and suppurate. It is seldom necessary to operate upon acute infections in the pelvis until the patient has developed immunity, a fact which was long ago established by gynecologists. (This principle applies to acute infections in most other parts of the body and has only recently been adopted in the treatment of acute infections of the chest.) The wound in these cases should consequently seldom suppurate.

The danger of contamination of the abdominal wound is considerable in cases of cancer of the cervix, especially in advanced cases which almost invariably have deep-seated infections. There is also considerable danger of infection in cases of hysterectomy when a fibroid polypus protrudes into the vagina.

A considerable difference of opinion exists relative to the length of time which should intervene in acute pelvic infections between the termination of the acute infection and the operation. We believe there is relatively little danger of infection of the wound in these cases when the operation is done a few days after the temperature has become normal and leucocytosis has disappeared, that is, after the patient has developed general immunity to the infection.

The statistics on operation for cancer of the cervix emphasize the great importance of thorough cleansing of the vaginal canal and cauterization of the cervix before making abdominal section. In cases of submucous infected polypus we believe it highly important to remove the polypus and to wait about 2 weeks before doing abdominal hysterectomy. We have been disappointed occasionally in the result where the operation was done 2 or 3 days after the polypus was removed.

For some years we have used alcohol, as has been advised, rather freely in the peritoneal cavity and abdominal incision in infected and contaminated pelvic cases. It has seemed that this has at times prevented suppuration of the abdominal wound.

The question of the use of drains in cases where suppuration is anticipated is of interest and value. It has been more or less customary to establish vaginal drainage in some cases with the hope of protecting the abdominal wound from infection. My experience has been that the use of vaginal drainage for this purpose has been disappointing. It does not protect the abdominal wound from infection, because the drain cannot possibly reverse the current in the blood vessels and lymphatics, and consequently cannot be expected materially to protect the abdominal wound.

TREATMENT

The general principles of treatment of infected abdominal wounds is the same as for wounds in other parts of the body. The author does not claim anything original in the treatment of these cases but is convinced that the general custom is to overtreat these wounds and consequently to delay repair, unnecessarily to disturb the patient, and to impair the strength of the abdominal wall.

Some phases of the general subject of infection and immunity are important to have in mind in the treatment of these wounds, namely: The infection does not long remain localized. Cases of infection which do not suppurate are often quite as acute and prolonged as cases which do suppurate. The presence of pus is therefore not of paramount importance. These wounds heal very slowly as long as fever persists. When the patient's temperature becomes normal the repair of the wound rapidly takes place. It is not always possible to estimate the relative importance of the local infection and of the systemic invasion. In many, if not in all, of these cases the treatment of the systemic infection is more important than the direct treatment of the wound. The

[1]Read before the American Gynecological Society, May 25, 1920.

Fig. 1. Mrs. W. F.

possible value of spontaneous autovaccination and destruction of the bacteria by their own toxins is worthy of consideration.

The treatment which we use has become considerable of a routine: no sutures are removed until the wound is healed unless it becomes necessary on account of extensive cutting of the sutures into the tissues; no drainage is inserted; no probing is permitted. Moist dressings are kept continuously over the wound as long as it remains reddened or indurated. Care should be exercised, however, not extensively to macerate the parts with moist dressings. The value of moist dressings consists almost entirely in preventing desiccation of the secretions and thus in favoring drainage. A large amount of drainage can efficiently take place through a small opening when thus treated. We generally employ a solution of boric acid for the purpose of preventing decomposition. We have tried some of the newer remedies which were advocated during the period of the war, but found them no better than the boric acid dressings. Experiments made a long time ago proved that the use of antiseptics in wounds did more damage to the tissues than injury to the bacteria; that wounds treated without antiseptics recovered more rapidly than when treated with them. Exception may be made to the use of chlorinated solutions in wounds which contain considerable necrotic tissue, a fact which has been well expressed in the writings of Sir Berkeley Moynihan. The use of antiseptics, irrigations, and drains materially injures the delicate tissue-repair present in healing wounds. We make no exception in cases of infected wounds complicated by intestinal fistulæ. Sinuses indicate the presence of a foreign body or dead tissue; if the sutures or ligature material used is catgut no special treatment is necessary. The so-called drains are not necessary as the wound will drain sufficiently without them. They quite as often interfere with as promote drainage. The experience is common that considerable discharge takes place after the so-called drain is removed, which is proof that it has been obstructing drainage. This is often especially true when gauze is used for supposed drainage purposes.

Fig. 2. Mrs. H. F. L.

Important features of this treatment of infected abdominal wounds are that no pain is inflicted and that the patient is very little disturbed mentally by the presence of infection, as one can give assurance that the suppuration is of minor importance. The question of systemic treatment of patients with infected abdominal wounds is not presented for discussion in this paper.

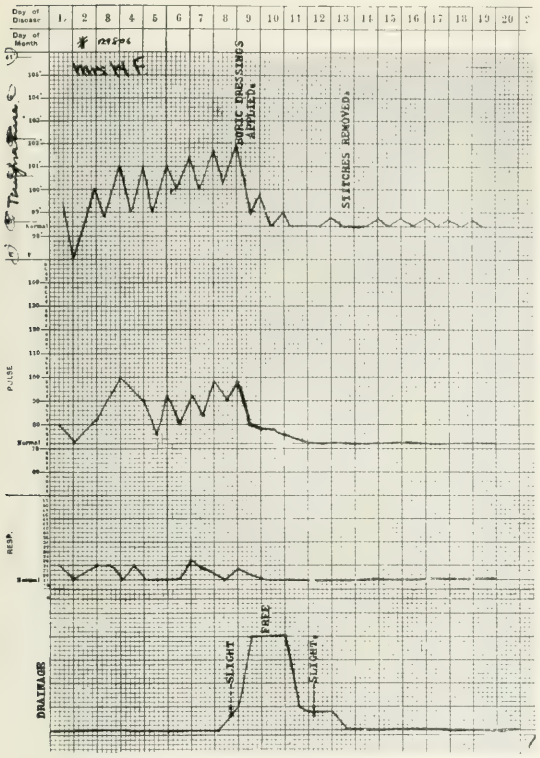

Fig. 3. Chart for case W. F.

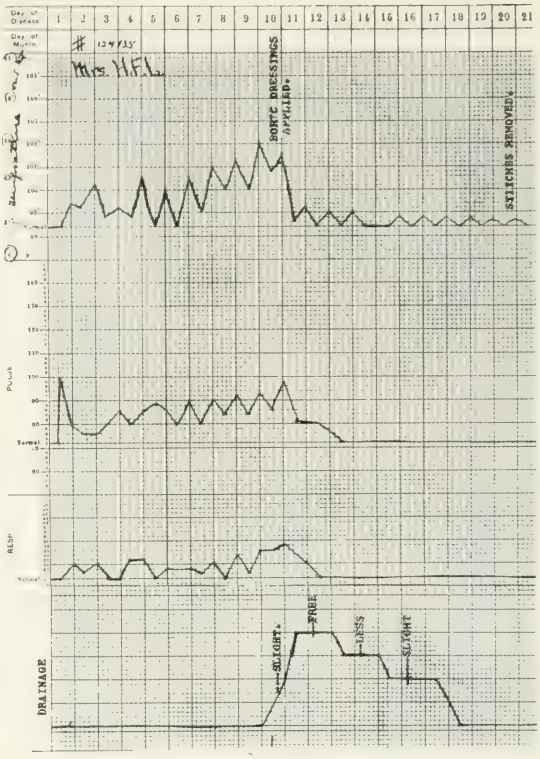

Fig. 4. Chart for case H. F. L.

We have been treating wounds in this manner for about 15 years. I read a paper before the Chicago Medical Society in 1907[1] and the treatment then advocated was practically the same as the one now given. The results have been that the patients almost invariably recovered sooner than they did when we used more energetic treatment. The abdominal wall has almost invariably been as strong as in cases where no suppuration took place.

A brief report of the following two selected cases well illustrates the results obtained with the above treatment, as they represent the extremes of mild and severe cases.

Mrs. W. F., No. 129,806, was operated upon for an extensive, infected cancer of the cervix. The maximum temperature for 7 days was consecutively 100°, 101°, 101°, 101°, 101.4°, 101.6°, 101.8°, and then became normal. The pulse curve varied with the temperature. Wet boric acid dressings were applied as soon as drainage appeared, which was on the ninth day, and were continued for 3 days. The drainage was profuse, purulent, and offensive, requiring frequent changing of the dressings. The drainage all took place through small openings in the edges of the wound. The sutures were removed on the thirteenth day, which is about the time we generally remove sutures. The patient was discharged from the hospital on the twentieth day. The photograph taken on the fifteenth day after operation (Fig. 1) fails to show any signs that suppuration occurred. The patient was examined about one month later and the strength of the abdominal wall was tested by palpation, by sitting exercises, and showed no evidence of having been impaired by the suppuration.

Mrs. H. F. L., No. 134,135, was also operated on for an extensive infected cancer of the cervix. Her temperature was 100.4° on the second postoperative day and reached a maximum of 102° on the ninth day. A slight purulent discharge appeared on the tenth day and became very profuse, purulent, and offensive upon the eleventh day. Moist boric acid dressings were applied from the ninth to the thirteenth day. The discharge became slight on the fifteenth day and disappeared on the seventeenth day. The sutures were removed on the twentieth postoperative day. A uterovaginal fistula resulted, which was successfully treated later. The photograph taken the twenty-third day after operation fails to show any indication of the wound having suppurated (Fig. 2). Sitting-up tests to determine the strength of the abdominal wall show no evidence of any impairment from the suppuration.

The charts (Figs. 3 and 4) illustrate the relations of the temperature to the pulse,—fever and suppuration.

SUMMARY

1. No sutures are removed on account of the suppuration.
2. No drains are inserted.
3. No probing is permitted.

[1]Illinois M. J., 1907, September.

4. Wet boric dressings are kept continuously applied until induration and excessive redness of the wound disappear.

5. Experience shows that this treatment secures efficient drainage.

6. No appreciable cavity is present at site of suppuration when wound is draining; intra-abdominal and atmospheric pressure keep suppurating surfaces in relative apposition.

7. When drainage ceases no open wound exists.

8. Experience extending over fifteen years has demonstrated that with the above treatment the infected wounds have healed in less time, the patients have been much less disturbed, and the abdominal wound has been left much stronger than when I employed energetic treatment.

SAVING SUPPURATING INCISIONS[1]

By HUBERT A. ROYSTER, M.D., F.A.C.S., Raleigh, N. C.

A PLAN for preserving abdominal incisions, which have suppurated deeply, and for preventing them from breaking down, has been employed in my hospital services for several years. The results have been so encouraging that the technique is herewith presented with confidence. Most frequently the method is applicable to appendiceal incisions, but it may also be used in infected wounds of any kind.

The fundamental question of drainage enters at once into our consideration. Some of us have come to believe in the reverse of the old motto, and when in doubt we do not drain. The perfectly frank suppurating abdomens require an outlet; these admit of no doubt and we drain them. But the cases concerning which we are in doubt rarely ever require a drain, because the condition is mild, not convincingly infectious; otherwise we would not be in doubt. In such cases the abdomen may be closed with safety, yet there are many good surgeons who continue to put in drains when they find murky serum in the cavity or are confronted with a gangrenous appendix, even when it is enveloped in omentum, and unruptured.

Fig. 1.

There have been three steps in the advancement of surgery. Formerly we operated to save life; later we operated to save health; now we operate to save time. The economic side of surgery is most important. The greatest loss of time from abdominal operations occurs in cases that are drained, so that any method that reduces the confinement period to a minimum is desirable.

When drainage is needed, it becomes a matter of great economic value to use stab wounds outside of the incision rather than to place a drain through the incision. When this is done, in 8 out of every 10 cases the wound is kept intact, heals perfectly and drainage is efficient and safe.

In some of the types referred to as doubtful, in which the abdomen is closed, the wound suppurates, though the abdominal cavity remains free from infection. It is well known that the resisting power of the tissues of the abdominal wall is not so strong as that of the peritoneum. One is not surprised, therefore, when a leaky appendix is smeared over the open wound or a tight one ruptures in lifting it out, to observe a swollen and tender area around the incision 4 or 5 days later. As a rule the focus of this infection is under the aponeurosis and within the fibers of the internal oblique muscle. If the incision is closed loosely, suppuration is not so apt to result.

[1]Read before the North Carolina Medical Society, April, 1920.

Fig. 2.

Supposing now that the wound has suppurated, as described, we will be apprised of its occurrence by continued pain near the incision, a possible rise of temperature, and, on inspecting the region, an œdematous, bulging area to one side or the other of the incision. In the McBurney incision this swollen area usually is seen to the outer side of the wound (Fig. 1). As soon as the condition is recognized, a small spot of skin at the most prominent part is injected with a local anæsthetic, and a bistoury plunged deeply downward and inward. Through this small stab the pus is evacuated (Fig. 2), aided by pressure upon each side. When the small cavity is emptied a quantity (equal in amount to the pus removed) of a 10 per cent melted iodoform-vaseline ointment is introduced by means of a glass syringe (Fig. 3). This distends the cavity, fills the interstices, and solidifies on cooling. A cold wet compress is immediately applied over the whole area, and an ordinary dressing over this. As a rule, the wound is not disturbed for 4 days, when on removing the dressing the incision and the suppurating area will be found clean and intact. Slight pressure will cause any excess of ointment to exude and another cold compress may be put on. If before the fourth day a discharge be noted through or around the dressing, the wound again may be emptied by pressure and a second injection of the ointment made, following the same plan in the after-treatment as outlined above.

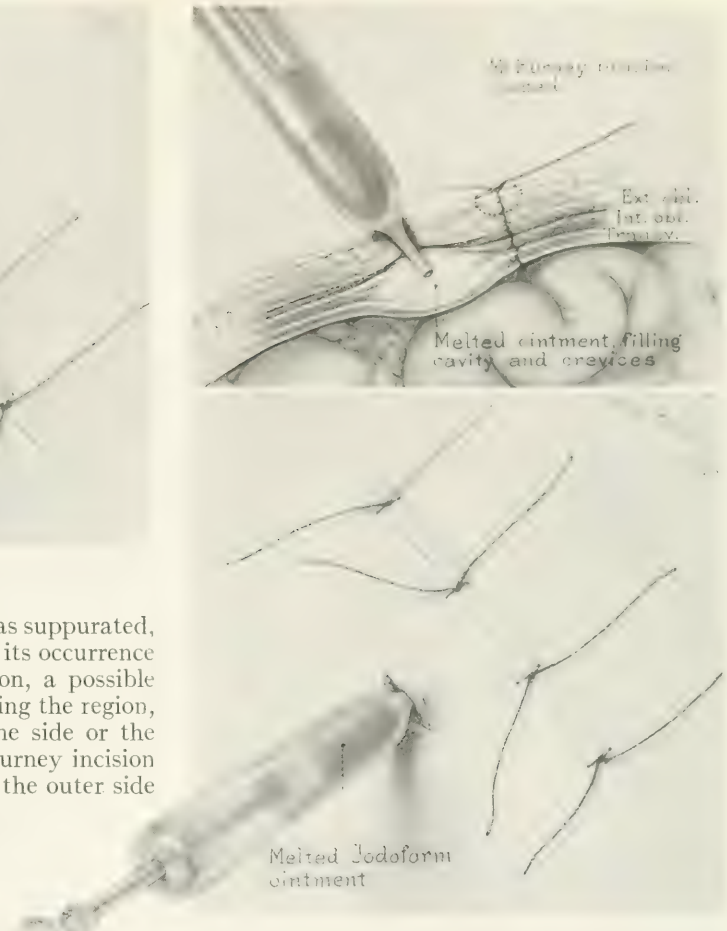

Fig. 3.

The only advantage of the iodoform is its odor, which counteracts that of the colon bacillus in the pus. The melted ointment method is not new with me or possibly to others. As long as 20 years ago I used it in the treatment of suppurating buboes and ischiorectal abscesses[1], and have continued to employ and recommend it ever since with the utmost satisfaction. Other substances besides iodoform may be incorporated with the vaseline; but having tried many different powders I still prefer iodoform. In this type of cases it is certainly superior to bismuth. It is admitted that simple vaseline would be sufficient in many instances, except for the absence of deodorizing qualities. Before introducing the ointment the wound cavity may be washed out with Dakin's solution or a weak dilution of hydrogen dioxide; we have not found this essential.

[1]New York M. Rec., 1911, Feb. 25.

RESECTION OF THE CLAVICLE TO ACCOMPLISH COAPTATION OF THE DIVIDED BRACHIAL PLEXUS

By H. M. RICHTER, M.D., F.A.C.S., Chicago, and K. LEROY VEHE, M.D., Cheney, Washington

AMONG the factors controlling return of function after nerve suture is careful coaptation of the severed ends from which all scar tissue has been removed. To accomplish this, close approximation without tension has often tried the surgeon's ingenuity.

Where sufficient nerve structure is missing to prevent the approximation of their ends, various devices have been utilized to bridge the gap. Various methods including the splitting of the nerve and turning down the ends, and the grafting of segments of nerves, tubulization with fascia, fat and veins, etc., all lag far behind the approximation of the nerve ends themselves in the results obtained. The ingenious method suggested by Elsberg and others of forming nerve grafts of sufficient size by utilizing several segments placed side to side, so as to make the groups equal at least in size to the missing segment, is probably a material advance in the development of nerve grafting. At best, however, nerve grafting must offer a comparatively inadequate substitute for end-to-end suture. The displacement of a nerve trunk to shorten the gap offers a means in a few cases of approximating the separated ends. This applies particularly to the ulnar nerve at the elbow.

The shortening of the bony framework has been suggested and in some instances, I believe, offers an ideal method for furthering the approximation of nerve ends.

A recent experience with two cases of brachial plexus injury offered an opportunity to carry out this method and solve the technical difficulties of both approach and approximation of the divided nerve in this structure.

The cases which are the basis of this report had both been operated upon by competent surgeons who had found it impossible to approximate the nerve ends. These were old cases with the usual retraction and scar tissue formation.

The procedure that was carried out is as follows: An incision is made extending from the middle of the posterior border of the sternomastoid muscle, downward and outward across the middle of the clavicle, then passing down toward the inner border of the humerus, ending at the lower border of the pectoral muscle. A free dissection is made, dividing all the superficial structures, including the transverse cervical vessels, and separating the fibers of the pectoral and deltoid muscles. The pectoralis minor is severed near its insertion (to be reunited later). The large axillary vessels are immediately laid bare to facilitate the further dissection without danger. The clavicle is freely exposed, and the middle third or more removed with a Gigli saw. This gives free access for the minutest dissection. Even the seventh and eighth and first dorsal nerves can be freed with remarkable facility by pushing the shoulder medianward and retracting the anterior scalenus muscle. The plexus becomes so relaxed and redundant that it can be picked up in a fold. The basic principle in nerve suture work, that of thorough removal of all scar tissue before the approximation of the ends is attempted, can now be carried out without fear of lack of tissue.

In our cases the gap left by the removal at the middle portion of the clavicle was not bridged in any way. Following the operation the weight of the arm and shoulder was supported by external dressings. It may be desirable to approximate the two segments of the clavicle left behind in order to bring the shoulder nearer the median line, and in this way permanently lessen the tension on the nerve trunks. It seemed better, however, to elevate the shoulder and depend upon external support, and the plexus was obviously under less tension in this position. In addition to the usual after care of a nerve suture case, it is particularly important that the weight of the arm and shoulder should be supported for many weeks.

Many operators have sectioned the clavicle simply as a method of approach and have resorted to nerve anastomoses, nerve transplantation, suture *à distance*, tubulization, and other means to bridge gaps. Markow, Kilb, and Peck used postural methods to obviate difficulty with short nerve segments. The first two raised the shoulder and inclined the head toward the lesion. The latter suspended the arm vertically and later flexed the arm with the hand behind the head.

Sands, in 1888, divided the clavicle to obtain easy access to a brachial plexus rupture in which there was no difficulty in approximating the divided nerves. He wired the clavicle and removed the wires in 16 days. Sands stated that Schede previously had divided the clavicle in excising high axillary and low cervical carcinomata.

Fig. 1. Note that the removal of the middle two-fourths of the clavicle gives perfect access to the brachial plexus, both to its origin in the cervical nerves and to its termination in the various nerve trunks.

Thorburn, in 1900, and Cathcart, in 1901, practiced section of the clavicle in order to reach the brachial plexus lesion. The latter's case was one of complete rupture and after freshening the nerve ends he was obliged, because of the large gap, to split the nerves and turn down a section to accomplish approximation.

Legueu, in 1902, criticised Thorburn for his division of the clavicle as dangerous to the great vessels in the region and described a method used by himself in which he made two incisions, one parallel to the sternomastoid in the posterior triangle of the neck and the other transverse in the subclavicular fossa.

Taylor, in 1908, reporting a birth palsy operated upon 2½ years previously, stated that he had bridged a gap of 2 centimeters with catgut strands, and noted that his success in this case was contributed to by the age (1 year) of his patient. All regenerative processes are much more vigorous in children. To quote him relative to clavicle section: "It is my personal opinion that the clavicle should be divided near its middle and the fragments allowed to override so as to permit of close approximation or direct opposition of the nerve ends. Certainly an extremity with returned muscle power, even at the expense of great deformity of the clavicle and shoulder, is much to be preferred to one which is permanently paralyzed." He further advises plastic work on any deformity which may exist after nerve regeneration is well advanced or complete.

Again, in 1917, Taylor in operating upon an extensive brachial plexus rupture accompanied by a clavicle fracture, did a subperiosteal resection of this bone, removed all callus, and then split the posterior layer of the periosteum to expose the nerves beneath.

Murphy divided the clavicle and wired it into position. In 1915 he sectioned it in two places

and turned it up in a flap, which at the close was sutured back into place.

Both simple section and osteoplastic resection of the clavicle are objectionable in that they serve only to give freer access without leaving the nerve trunks in a flaccid state. With the removal of a material section of the plexus or any of its trunks, a means of permanently shortening the clavicle is necessary to compensate for the loss of nerve length.

That the clavicle may be sectioned to gain access and removed in large measure to effect easy coaptation without fear of disability is evidenced by those cases in which it is congenitally absent. There is no need for any plastic work because the loss of a very material amount of the clavicle is not associated with any functional disturbance, and, except possibly in women, the defect is immaterial.

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CORRESPONDENCE

ARTERY OF THE UTERINE ROUND LIGAMENT

To the Editor: In regard to Dr. J. F. Baldwin's article on the "Artery of the Uterine Round Ligament" which appeared in the July, 1920, issue of Surgery, Gynecology and Obstetrics, I wish to relate my experiences with this artery.

In doing a hysterectomy I always have secured both round ligament arteries. Repeatedly when one of these vessels has not been tied while removing the uterus, there has been a decided bleeding. I have never seen a round ligament artery cut without decided bleeding and I know of one case where death occurred, the bleeding taking place into the peritoneal cavity from a right round ligament artery (diagnosis made by opening the abdomen). From an untied artery of the smallest size there should be oozing and no oozing should be left after a hysterectomy.

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AMERICAN COLLEGE OF SURGEONS

STATE AND PROVINCIAL CLINICAL SECTIONS

ARIZONA, California, Utah, Colorado, and New York have recently held their first clinical sectional meetings. As was the case at similar meetings held previously in Montana, Idaho, Oregon, Washington, and Pennsylvania, every effort was put forth by the committees in charge of the various sessions and by the Fellows of the College in these states to enlist the interest, not only of the medical profession, but of the public as well in raising the standard of surgery throughout the country.

ARIZONA

The first annual session of the Arizona Section took place in Phoenix on November 15 and 16. The mornings of these two days were devoted to clinics at St. Joseph's Hospital.

The address of welcome at the public meeting, held at eight o'clock of the evening of November 15, was delivered by Governor Thomas E. Campbell. Dr. Franklin H. Martin, Secretary-General of the American College of Surgeons, spoke on the "Organization of the American College of Surgeons"; Dr. Frederic A. Besley on "How the People of Arizona Can Help the Medical Profession"; and Mr. John G. Bowman, Director of the College, on the "Standardization of Hospitals."

A buffet luncheon was served to the Fellows and guests at 12:30 o'clock on November 16, immediately following which a scientific meeting was held at St. Joseph's Hospital. At this meeting talks as follows were made: "Diagnosis and Treatment of Skull Fractures," by Dr. Frederic A. Besley of Chicago; "Organization for Better Surgery," by Dr. Franklin H. Martin; "the Surgeons' Responsibility to the Public," by Mr. John G. Bowman; "Some Cardinal Points to Be Observed in Tendon Transplantation," by Dr. R. D. Kennedy of Globe; and "Linitis Plastica," by Dr. E. Payne Palmer of Phoenix. This session was followed by the annual meeting of the Arizona Fellows.

CALIFORNIA

On November 18 and 19 the first annual session of the California Section of the Clinical Congress of the American College of Surgeons was held in San Francisco. Clinics were given during the mornings at various institutions.

At 2:30 p.m. of November 18, a scientific meeting was held in the ball room of the Palace Hotel, and in addition to addresses by Dr. Besley, Dr. Martin, and Mr. Bowman, the following papers were read: "What Are We Doing with the Cancer Problem," by Dr. Harry M. Sherman, San Francisco; "Results of Radium Treatment of Carcinoma of the Cervix," by Dr. F. W. Lynch, San Francisco; and "Progress in Surgical Treatment of Cancer," by Dr. Stanley Stillman, San Francisco. The annual meeting of the California Section of the Clinical Congress of the American College of Surgeons and of the Executive Committee followed this scientific session.

The public meeting was held in the ball room of the Palace Hotel at eight o'clock in the evening of the same day. United States Senator-elect Samuel H. Shortridge delivered the address of welcome. Mr. Celestine J. Sullivan, Executive Secretary of the League for the Conservation of Public Health, spoke on "Public Health in the Light of the Work of the American College of Surgeons." Dr. Frederic A. Besley, Mr. John G. Bowman, and Dr. Franklin H. Martin also addressed this public meeting.

In the rooms of the San Francisco County Medical Society, at 2:30 p.m., November 19, a demonstration of cases and exhibition of pathological specimens and surgical apparatus was given by Fellows of the College, and a demonstration of hospital methods by Dr. W. E. Musgrave.

UTAH

Salt Lake City entertained the first annual session of the Utah Section on November 22 and 23. Clinics at the various hospitals were held during the mornings of these two days.

At eight o'clock of the evening of November 22, a public meeting was held in the ball room of the Hotel Utah. The meeting was presided over by Bishop J. S. Glass. Judge Harold Stephens spoke on the "Relation of the Public to the Medical Profession," and talks were made by Dr. Franklin H. Martin, Dr. Frederic A. Besley, and Mr. John G. Bowman, of Chicago.

A scientific session was held at 2:00 p.m. on November 23. Mr. Bowman spoke on the "Responsibility of the Surgeon to the Public"; Dr. Ezra C. Rich of Ogden on "Operations for Hernia"; Dr. Franklin H. Martin on "Organization for Better Surgery"; Dr. Frederick Stauffer of Salt Lake City on the "Modern Mastoid Operation"; Dr. R. T. Richards of Salt Lake City on "Case Records"; and Dr. Frederic A. Besley on "Diagnosis and Treatment of Skull Fractures."

The annual meeting of the Utah Fellows of the College, and of the Executive Committee of the State Section, was held at eight o'clock of the same day.

COLORADO

The Colorado State Section of the Clinical Congress of the American College of Surgeons held its first meeting in Denver on November 26 and 27. On the morning of November 26 clinics were given at St. Joseph's Hospital, the Children's Hospital, the National Jewish Hospital for Consumptives, and the County Hospital. A luncheon to the Colorado Fellows and guests was given at the Civic and Commercial Association at 12:30 o'clock of the same day, and at 2:30 p.m. a scientific session was held in the hall of the Denver County Medical Society. This meeting was addressed by Dr. Martin and Dr. Besley, and was followed by the annual meeting of the Colorado Fellows and Executive Committee.

The public meeting was held at the Central Presbyterian Church, the program being as follows: Opening address by Dr. Edward Jackson, Denver; address of welcome by Mr. Thomas B. Stearns, chairman of the meeting; "Why the Church is Interested in Medical Education for the Laity," by The Right Reverend Irving P. Johnson, Reverend Father David T. O'Dwyer, and Rabbi W. S. Friedman; the "Control of Cancer," by Dr. Charles A. Powers of Denver; and papers by Dr. Frederic A. Besley, Dr. Franklin H. Martin, and Mr. John G. Bowman.

During the morning of November 27, clinics were given at the different hospitals. A scientific session was held on the afternoon of the same day with addresses by Dr. M. S. Henderson of Rochester on "Non-Union of the Humerus," and by Mr. John G. Bowman, followed by a discussion of clinical material.

NEW YORK

Buffalo was selected to act as host for the first annual session of the New York Section of the Clinical Congress of the American College of Surgeons, held on December 2 and 3. From 9:00 a.m. to 1:00 p.m. of these two days, surgical clinics were given at the different hospitals, and demonstrations of basal metabolism in thyroid patients were also given at the Buffalo City Hospital by Dr. J. A. P. Millet, and at the Buffalo General Hospital by Dr. B. D. Bowen.

A scientific meeting was held in the ball room of the Lafayette Hotel at 2:30 p.m., Thursday, December 2. Dr. John B. Deaver, the President-elect of the College, delivered a paper on "Perforating Peptic Ulcer." Dr. John Osborn Polak of Brooklyn spoke on "How the Pathology Explains the Symptoms of Ectopic Pregnancy." Talks were also given by Dr. Martin and Mr. Bowman. This session was followed by the annual meeting of the New York Section, and of the Executive Committee.

At the public meeting, held in the Hutchinson High School Auditorium at eight o'clock Thursday evening, December 2, Mr. George C. Diehl, President of the Rotary Club, delivered the address of welcome on behalf of the Mayor of Buffalo. Dr. John B. Deaver spoke on "How the People of New York Can Help the Medical Profession." Dr. Martin and Mr. Bowman spoke briefly, and the closing address was given by Mr. Walter P. Cooke.

At a scientific meeting held at 2:30 p.m. on December 3, Dr. Carl Huber, of the University of Michigan, delivered a paper on "Nerve Surgery," and Dr. R. E. Farr, of the University of Minnesota, on "Local Anæsthesia."

Pathological demonstrations at the Museum of the Medical Department, University of Buffalo, were given during Thursday and Friday mornings.

MEETINGS SCHEDULED TO BE HELD

During January State Sectional meetings are scheduled to be held in southern states, as follows:

Texas—Dallas, January 7 and 8.

Louisiana—New Orleans, January 10 and 11.

Georgia—Atlanta, January 14 and 15.

South Carolina—Charleston, January 17 and 18.

North Carolina—Charlotte, January 20 and 21.

An invitation will be extended to the Oklahoma Fellows of the College to meet in Dallas with the Texas Section; to the Fellows of Mississippi and Arkansas to meet in New Orleans with the Louisiana Section; and to the Fellows of Florida and Alabama to meet in Atlanta with the Georgia Section.

A complete report of the meeting of the Illinois Section of the Clinical Congress of the American College of Surgeons, to be held in Peoria on December 16, 17, and 18, will appear in the February issue of the Journal.

SURGERY, GYNECOLOGY AND OBSTETRICS

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MORTALITY AND END-RESULTS IN SURGERY[1]

BY WILLIAM J. MAYO, M.D., ROCHESTER, MINNESOTA

MUCH may be learned by a study of the mass of surgical material which passes through an institution. In order to secure a perspective which will not be distorted by the minutiæ the mass rather than the details should be considered. Such an investigation will sometimes point out a way by which an intensive study of outstanding failures may be made to yield valuable suggestions. I have been impressed with this fact by a survey of the statistics for the past year from the institutions in Rochester. These statistics indicate that some deaths and many poor end-results apparently due to accidental or unpreventable causes occur with a regularity so definite that their incidence can be foretold from year to year. That which can be foreseen can be prevented.

It is difficult to secure comparable statistics from different hospitals. In one hospital the surgeon bases, on all the facts known to him, his conclusions that a death should or should not be attributed to the operation; in another hospital all deaths that occur within 2, 3, or 4 weeks after operation are counted as deaths from operation; while in another, patients with medical complications, such as pulmonary lesions following a surgical operation, are transferred to the medical side of the hospital, and if deaths follow they are classified as medical deaths. In the plan adopted at St. Mary's Hospital more than 20 years ago all deaths in the hospital are charged to operation, without regard to the length of time thereafter or the actual cause of death. This occasionally produces a grotesque result, for example, a patient commits suicide after a trivial operation, or a patient after an exploration in which advanced carcinoma is found remains in the hospital until death occurs, since only in a hospital can he be cared for properly. Sometimes, on the other hand, if an exploration is made and the condition found inoperable the patient is permitted to return home in a few days if his family can care for him since nothing is to be gained by keeping him in the hospital. Yet if he had remained in the hospital he would have died within 2, 3, or 4 weeks. In detailed instances, injustices can be cited either way, but on the average the method is not essentially unfair.

In 1919, 10,280 operations were performed by ten surgeons working under similar conditions in St. Mary's Hospital, with a mortality rate of 1.7 per cent. Five thousand, six hundred seventy-one of the 10,280 operations were performed for conditions involving the abdominal cavity; it is of these cases I wish to speak.

OPERATIONS ON PELVIC ORGANS OF WOMEN

Two hundred sixty-five operations were performed on the ovaries and fallopian tubes for cancer of the ovaries, all types of ovarian cysts, tuberculosis of the tubes, extra-uterine pregnancy, pus tubes, infections, and so forth, with a mortality rate of 0.7 per cent. Comparing these statistics with those of former

[1] Retiring President's address before the Clinical Congress of the American College of Surgeons, Montreal, October, 1920.

years, I find that for years the operative mortality in such cases has been low. Shall such excellent results be ascribed to greater knowledge of the pathological conditions and to technical skill or partly to certain factors the importance of which we have not fully realized? First, the pelvic peritoneum of woman has, through heredity, a remarkable degree of protective ability and the shape of the pelvis and its surroundings mechanically aid localization of infections. Second, the omentum and the epiploic tags of the pelvic sigmoid have great power to destroy noxious agents and absorb the residue. Perhaps, too, the aseptic condition of the ovaries and tubes contrasted with the septic condition in the gastro-intestinal tract is a contributing factor. The end-results of such operations on the pelvic organs of women, however, are by no means comparable with the low mortality. The disturbance of the endocrine functions in which the ovary plays so important a part, especially in young women, leaves serious neuropathic sequelæ, and an intensive study of conservative methods by which such sequelæ can be averted is relatively of greater importance than the study of mortality.

Five hundred thirty-nine hysterectomies were performed with a mortality rate of 1.6 per cent. Considering the serious character of the operation necessary in this group of cases the mortality is not unsatisfactory. However, because of the abolition of menstruation in such patients, there is again the necessity in benign disease for the study of more conservative methods in order to prevent when possible the type of endocrine disturbances which occur after radical operations on the ovaries and tubes, and serve to heighten our interest in conservative myomectomy for myomata instead of in destructive measures, such as hysterectomy and radium. For other than neuropathic reasons the end-results of hysterectomy for benign disease are not always satisfactory. Subtotal hysterectomy does not give such good end-results as total hysterectomy. The cervix remaining is an average cancer liability, and cystic degeneration of the cervix sometimes follows which causes an acrid leucorrhœa and excessive shrinkage of the vagina requiring subsequent removal of the cervix for relief. It is rare that a patient on whom a total hysterectomy has been performed has local complaint following operation. Therefore, looked at from the standpoint of end-results, if hysterectomy is necessary, total hysterectomy is a more conservative operation than subtotal hysterectomy.

Statistics can be very misleading. Sir Berkeley Moynihan once remarked: "Statistics can be made to tell anything, even the truth." Ninety-six of the 539 hysterectomies were performed for carcinoma of the uterus without a death. This statement without explanation would be the truth, yet it might lead to false conclusions. The remarkable effect of radium in certain cases of cancer of the cervix has revealed an agent which can be applied more or less successfully to a large group of advanced carcinomata of the cervix that formerly gave rise to a high operative mortality. The results in these ninety-six hysterectomies are not fairly comparable with the results obtained in the average group of cancers of the uterus which were operated on in the preradium period. The treatment of carcinoma by radium previous to operation has much to commend it. The effect of the radium is produced during the hours that it is in place. The malignant cells become œdematous through disturbance of the circulation, the nuclei are destroyed or at least temporarily devitalized, and operation during this period of cell sickness is less liable to be followed by grafting of malignant cells, which, I believe, is one of the most frequent causes of recurrence of carcinoma following operation. Further study should be given to methods of treatment that combine radiumtherapy and surgical procedures in order that better end-results may ensue.

OPERATIONS ON THE BILIARY TRACT

In the series of 10,280 operations 1,000 cholecystectomies were performed with a mortality of 1.6 per cent. The operations were for acute infections, perforations, carcinomata, chronic infections, stones, and all other causes for which the gall-bladder is removed. Cholecystectomy has taken the place, to a large extent, of cholecystostomy

because of the well known fact that the gall-bladder following cholecystostomy is a liability rather than an asset to the patient. The mortality in this group is satisfactory, considering all the conditions affecting it, and the end-results with a few exceptions are excellent. Drainage hernia, which is ordinarily unimportant, may be of great importance in obese persons. Drainage is unnecessary in the average cholecystectomy and should be used only when indications are definite. A small percentage of infected common ducts will give rise to secondary troubles after either cholecystostomy or cholecystectomy, even though there were no stones in the common duct. Further study of this group of re-infections is needed.

One hundred thirty-nine operations were performed for stones in the common and hepatic ducts with a mortality of 8.6 per cent. This rate is high but the reason is manifest, that is, late intervention in neglected cases. Many of the patients were in wretched condition from cachexia, jaundice, and nephritis. By the use of preliminary transfusions and the restoration of the calcium content of the blood to normal we have been able to reduce a coagulation time (average normal, 5 minutes) from as high as 30 minutes to less than 12 minutes.

In one case of choledochotomy which ended in death, stones overlooked at operation were found in the common duct at necropsy; this humiliating experience was not our first. Stones in the common duct can be located and removed but it is difficult to be sure that there are no stones or fragments higher up in the hepatic ducts which may work down later, to the dismay of the patient and the chagrin of the surgeon. Greater care must be exercised to see that stone fragments are not left in the common and hepatic ducts. Careful dilatation of the duodenal end of the common duct permits normal bile drainage and may enable stones overlooked in the hepatic duct to pass out with the flow of bile. In a small percentage of cases olive-shaped or cartridge-shaped pigment stones reform in the common duct following choledochotomy and require a second or even a third operation for final cure. Experience teaches that unless there is obstruction with jaundice and definite cholangeitis the value of bile drainage to the surface following operations on the biliary apparatus has been overrated.

OPERATIONS FOR ULCER OF THE DUODENUM AND OF THE STOMACH

Seven hundred eleven operations were performed on the duodenum for acute and chronic ulcers and their complications, with a mortality of 0.9 of 1 per cent. The end-results are satisfactory in 95 per cent of patients with demonstrable ulcers. In cases in which proper operation does not give relief the rule is that there is no ulcer, and operation is performed on a mistaken diagnosis. We have cut off more than 200 gastro-enterostomies made in cases of this description. In fourteen of these cases the first operation was made in our clinic during our early work. The large majority of patients who have trouble following operation develop it within the first year. So far as gastrojejunal ulcers are concerned the end-results have been much better since we have substituted catgut for silk sutures. Some of the smaller duodenal ulcers, especially of the type that causes hæmorrhages, can be cured by excision with the knife or cautery, as practiced by Judd and Balfour, without gastro-enterostomy. The results of excision of large ulcers, because of hæmorrhage, with end-to-end union of the duodenum to the stomach by means of catgut, have been so excellent as to indicate an early return to the more localized treatment of certain duodenal ulcers, as advised by Finney, without recourse to routine gastro-enterostomy.

One hundred sixty-three operations were performed for gastric ulcer and its complications, with a mortality of 2.4 per cent. The end-results of operation for gastric ulcer are about 85 per cent satisfactory. The permanent crippling of the stomach produced by the ulcer and the cancer liability are two factors that cannot be ignored. Gastro-enterostomy often fails to cure gastric ulcer unless the lesion is obstructive at the pyloric end of the stomach, and excision often fails, unless the ulcer is small and on the cardiac end. After a suitable specimen is removed for frozen-section diagnosis excision by cau-

tery with gastro-enterostomy is the logical procedure, and in the large calloused ulcer partial gastrectomy is the operation to be preferred.

The summary of results in the foregoing groups of cases is on the whole satisfactory. Individual surgeons of skill and experience quote statistics of lower mortality and better end-results. The fact that these are not the result of the work of a single surgeon but of ten surgeons shows that they represent the average results of American surgeons. It is very evident that the American surgeon is taking his responsibilities seriously and the end-results in the groups discussed more than justify the surgical risks.

OPERATIONS FOR MALIGNANT DISEASE OF THE GASTRO-INTESTINAL TRACT

We come now to a different group, that of carcinoma of the gastro-intestinal tract, in which the mortality is high and is no longer a friendly guide, and the end-results are not so satisfactory. The death rate does not perhaps depend so much on technique as on the character of the case which the surgeon accepts for operation. One hundred five resections of the stomach were performed for cancer, with ten deaths. While this record is not the best from the mortality standpoint shown for a year in St. Mary's Hospital, it is the best considered from the standpoint of operability, because each year we have advanced the frontier, accepting for radical operation patients who would not have been considered in former years.

The radical operation was performed on sixty-three patients with carcinoma of the large intestine, with eleven deaths, and on seventy patients with carcinoma of the rectum and rectosigmoid, with seven deaths. Preliminary colostomies for obstructions, and subsequent operations besides the radical operation, sometimes three or more on a single patient, are counted as one case. It is difficult to justify this mortality rate, but the fact stares us in the face that operations performed even in advanced stages of this dreadful malady have resulted in permanent cures, when the condition left alone makes death welcome.

In our early experience operations for carcinoma of the large intestine and rectum gave a low mortality and a high percentage of five-year cures. However, when we began to consider every patient with cancer of the colon and rectum registered in the clinic, whether in a hopeless condition, whether operated on previously, or whether exploration, colostomy, or resection had been done, the results did not appear so good. The excellent showing was made only when we were operating on about 25 of 100 of these patients and although 50 per cent of those operated on were cured they were but 13 of the 100. When we operated on 50 per cent of the patients the mortality went up and the percentage of cures came down, but we had 9 more of the 100 cured. Finally we pushed the operative frontier up to 71.8 per cent. The mortality again went up and the percentage of cures, as would be expected, came down, but we had 5 more persons alive at the end of the 5 years, or 27 instead of 13 of 100 cured.

The well known facts that in the normally grossly infected areas of the intestine carcinoma does not involve the glands early but late, that often when the glands apparently are involved they show only infection, and that the fixation and involvement of the surrounding tissues may still leave the disease local is my excuse, if an excuse is necessary, for some of the radical operations I have performed. I have resected two loops and several times three loops of the small intestines adherent by their periphery to the carcinomatous growth, with end-to-end union, removing part of the wall of the bladder, the pelvic colon, and the entire rectum, and the end-results have been so remarkable as to justify the primary mortality. We are sometimes tempted to perform a permanent colostomy and turn the very bad cases over for radium treatment, as in cancer of the cervix. This may eventually prove wise, but as yet I have seen no cures from radium treatment in cases of this description, although great palliation is sometimes secured. Preliminary colostomy for the purpose of cleansing the part to be operated on, of keeping the wound clean after operation, and especially for the

use of radium in the growth before operation, effects a reduction of mortality and improves end-results. The advantage gained in this manner, however, is at once lost by the extension of operability.

One may well ask why preliminary operations, drainage, and colostomy should not be done in all cases. There are certain conditions which, if treated by temporary palliative operations, for one reason or another, never come to a radical operation that will cure. This is particularly true of the infections around cancerous growths of the sigmoid which are rapidly followed by extension of the carcinoma in the adjacent structures. Much of the credit given two-stage operations is due to the fact that the secondary resection may not be done in the bad cases in which there is no improvement after the first stage, and they are thus automatically eliminated from the record. The same is true of the two-stage operations for cancer of the stomach.

Colostomy should be done in cases of acute obstruction, but not necessarily in other cases; while it temporarily benefits the patient too often he dies later without further effort for cure, thus relieving the mortality sheet of a heavy load, but the patient is just as dead as though he had died of a one-stage radical operation which would at least have given him a fair chance. Further, I am convinced that if the peritoneum over a growth is handled some days before its removal early peritoneal extension may result. When, as in cancer of the rectum, the growth lies below the peritoneum, preliminary colostomy is generally indicated.

The two great causes of death following operation in these cases are sepsis and secondary pulmonary complications. Such pulmonary complications are too frequently attributed to the anæsthetic. We have found them just as frequently in cases in which local anæsthesia was used. The mere act of handling such infected masses may set free cancerous or septic emboli and cause pulmonary complications which are the immediate perhaps rather than the primary cause of death The peritonitis found at necropsy may have the same relation to the operation, that is, not a primary death-producing peritonitis, but essentially terminal.

The study of the mortality in this group of cases has been most profitable. We have secured necropsies on nearly all the patients who died. The necropsies in my cases showed that some of the patients who died following operation were in hopeless condition and should not have been operated on. In others death occurred as the result of circumstances more or less avoidable. If these latter operations could be performed again undoubtedly they could be done better; in any event if we do our duty by these unfortunate patients there will be a considerable mortality.

The value of careful exploration to prevent unavailing operations is obvious. The relief of acute obstructions before the radical operation is performed, the improvement of measures to render the intestinal site of operation clean and free of fluids, and finally, during operation, early control of the circulation and gentle manipulation of the growth to prevent septic or cancerous hæmatogenous infections will do much to improve results.

To turn from mortality to end-results is a more cheerful task. Few operations on the human body for cancer give end-results so favorable as operations on the large intestine. McVay has recently studied the findings from a pathological standpoint in our cases of cancer of the large intestine. An interesting side light was thrown on the end-results by the investigation. Exactly 50 per cent of the patients operated on more than 5 years before had lived more than 5 years. I have never perused more cheerful letters than those received in answer to inquiries. We were able to obtain information from 91.6 per cent of the patients: One was alive after 15 years, four after 14 years, seven after 12 years, and eight after 10 years; and the numbers of patients in the shorter periods showed corresponding increases. All types of operations resulted in cures; this was equally true of all types of radical operations for cancer of the rectum. The controlling factor was glandular involvement; 70.8 per cent of the patients without glandular involvement by cancer were cured.

LESSENED MORTALITY AND BETTER END-RESULTS

It seems almost idle to reiterate that early operation in cases of benign and malignant disease would reduce the mortality and give better end-results. The medical profession, however, is not in accord with regard to the necessary steps to bring this about, and it is not to be expected that the public will respect divided opinions. The surgeon is often intolerant and the internist self-sufficient. The patient, because he has a surgical complication, is arbitrarily assigned to a surgical ward; or a surgical patient, because the diagnosis is uncertain, is detained unduly in a medical ward. A very respectable minority of diseases are on the border-line. There should be hospital beds especially devoted to such border-line cases in which the diagnosis is doubtful or in which the indications for treatment are not clear, in order that a joint attack may be made on disease. One group of cases may be treated surgically, and another similar group medically, and direct comparison made from a noncompetitive standpoint.

Group medicine, in some form, is the only means by which the patient can receive the attention to which the advancement of medical science entitles him. A medical building with a medical library where physicians can meet, common access to laboratories containing modern means of diagnosis with good technicians in charge, the whole managed and controlled by the physicians of a community, would enable every patient, rich or poor, to obtain proper treatment. A basic fee may be charged each physician, the remainder of the expense to be divided in proportion to each member's use of the equipment. Arrangements for mutual consultations, for early diagnosis, and the proper handling of emergency cases should be made. The city's health and institutional work should also be performed by the medical group and the proceeds devoted to bettering the equipment of the laboratories. All of these desirable arrangements may be made possible by co-operation between the physicians of a community.

Properly considered, group medicine is not a financial arrangement, except for minor details, but a scientific co-operation for the welfare of the sick. Medicine's place is fixed by its services to mankind; if we fail to measure up to our opportunity it means state medicine, political control, mediocrity, and loss of professional ideals. The members of the medical fraternity must co-operate in this work and they can do so without interfering with private professional practice. Such a community of interests will raise the general level of professional attainments. The internist, the surgeon, and the specialist must join with the physiologist, the pathologist, and the laboratory workers to form the clinical group which must also include men learned in the abstract sciences, since physics and biochemistry are leading medicine to greater heights. Union of all these forces will lengthen by many years the span of human life and as a by-product will do much to improve professional ethics by overcoming some of the evils of competitive medicine.

THE SURGICAL TREATMENT AND THE PATHOLOGY OF GASTRIC AND DUODENAL ULCER[1]

By JOHN B. DEAVER, M.D., F.A.C.S., and STANLEY P. REIMANN, M.D., Philadelphia

THE discussion as to the merits of surgical versus medical treatment of peptic ulcer, it seems, may be expected to appear upon the program of our medical societies almost equally with the seasonal or periodic attacks of the disease.

I have repeatedly stated my belief that ulcers that present early symptoms and are treated early, especially in the acute stage, may heal by medical treatment, but I must emphasize the important fact that few ulcers give early symptoms that are recognizable as such. The rôle of focal infection as a causative factor of the disease, such as the tonsils, the sinuses and especially the appendix, the chief actor in the drama, is an important one. If the infection is recognized and properly treated before the ulcer forms, or when in its very early stage, much good can be accomplished, but after the ulcer has formed and its margins are indurated and calloused the treatment of focal infection, if present and acknowledged as responsible for the symptoms, will do about as much good as putting out a match after it has started a conflagration; or taking out an acute appendix in the presence of diffuse peritonitis, in the hope of arresting the peritonitis. Such a course is fallacious, unphilosophical and entirely illogical.

Peptic ulcer is an insidious disease and the symptoms are usually not aggressive until it is well established. Furthermore, the longer an ulcer remains unhealed the less amenable is it likely to be to surgical or any other treatment, and finally there remains the formidable danger of perforation, in about 7 per cent of cases, of carcinoma in a large percentage of gastric ulcers, as well as hæmorrhage and hæmatemesis from the unhealed ulcer. If these were the only reasons they would be sufficient for my persistent belief that treatment of chronic peptic ulcer is, with but few exceptions, essentially surgical. But the most incontrovertible argument for my belief is the 90 per cent or more of cures.

In my service at the Lankenau Hospital within the years from January, 1916, to January, 1920, I have treated 215 duodenal and 53 gastric ulcers; the average duration of symptoms in the series being 9.2 years. During the same time there were 19 cases of perforated ulcers of the duodenum and the stomach.

As a result of an inquiry sent in April, 1920, to 227 chronic ulcer patients (those operated upon in 1919 being omitted) I have received 103 (45 per cent) replies. Of these, 90 report freedom from symptoms, that is to say 90 per cent cured for a period of 2 or 3 years after operation. These were, of course, cases of actual ulcer visible to the eye and a larger number of them excised and examined microscopically, and not the symptomatic ulcers, or those demonstrated by X-ray with an error of 10 per cent or more that has to be reckoned with.

As to the best manner of treating ulcers by means of surgery, excision remains the operation of choice, but it cannot always be the chosen method, much depending upon the location of the ulcer, its size, the degree of involvement of the visceral coats, extent of induration, etc.

A small ulcer will probably involve only the mucous and submucous coats, while a larger one will encroach upon the muscularis, and some old callous ulcers will involve all the coats, and perhaps neighboring viscera especially the pancreas to which they are often adherent.

It is my practice whenever possible to excise the ulcer with knife or cautery.

When the ulcer has not to any great extent impaired the mechanism and the motility of the stomach, simple excision without a posterior gastro-enterostomy will suffice. But from the standpoint of *rationality and cure*, that is to say, subsequent freedom from symptoms, gastro-enterostomy is indicated in all cases that present marked hyperacidity

[1] Read before the County Medical Society, Philadelphia, May 26, 1920.

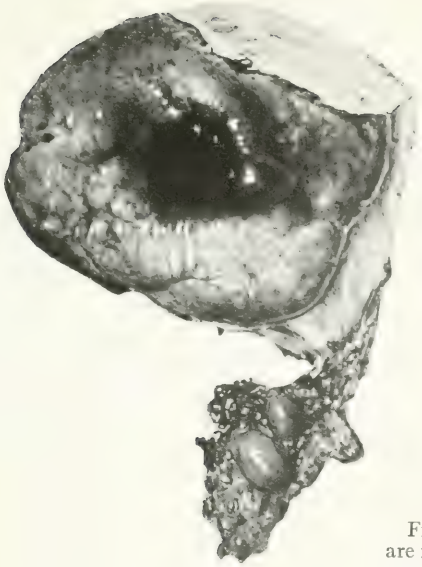

Fig. 1.

Fig. 2.

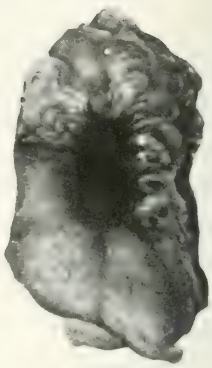

Fig. 3.

Fig. 1. Gastric ulcer. Chronic with acute exacerbation. The lymph nodes are not carcinomatous, but are enlarged from acute and chronic inflammatory products.

Fig. 2. Gastric ulcer. Fig. 3. Duodenal ulcer.

before operation. The rationale of the mechanism of the opening between the stomach and the bowel has been clearly pointed out by Paterson. He attributes the beneficial effects of the anastomosis to the neutralizing action on the gastric secretion of the duodenal and pancreatic juices which regurgitate into the stomach through the new opening. This produces a diminution of the total acidity of the gastric contents. This diminution, which Paterson estimates to be about 30 per cent, is not entirely due to the chemical process but to a great extent also to reduction of the total chlorides in the gastric contents as the result of diminished secretion. During the churning movements of the stomach some of the gastric juice is forced through the new opening. This together with the relief of the pylorospasm, formerly engendered by the hyperacidity, prevents the acidity from rising to its previous figure. A further escape of the acid into the jejunum promotes the secretion of the pancreatic juice. This earlier secretion of pancreatic juice in turn causes an earlier diminution of the gastric secretion, with consequent reduction in the total chlorides secreted by the gastric mucous membrane.

Charles Mayo likens the relation of ulcer and gastro-enterostomy to the process of scientific farming. The first thing a farmer does with a piece of dark, soggy soil is to drain it from beneath, and after the ground is dry he treats it with lime and then sows his crop and finally reaps his harvest. Similarly, gastro-enterostomy drains the stomach, the regurgitating duodenal and pancreatic juices act as lime or alkali on the gastric juice and prepare the soil for undisturbed digestion and a harvest of good health.

The relief afforded by gastro-enterostomy is generally so complete that the patient is apt to indulge in various kinds of food which he has not been able to enjoy for many years. Indeed, it is not uncommon to have patients declare themselves so well that they feel as though they could eat cobblestones. I do not advise the trial. It is well, however, to warn these patients of the necessity of restricting the diet for at least 6 months in order to give the chronically inflamed mucosa a chance to be restored to a healthy condition. And particularly, patients, who had a very high acidity before operation should be instructed to abstain from meat until gastric analysis demonstrates subnormal acidity. A number of replies to my inquiries speak of slight symptoms remaining for a few weeks after operation before there is a return to per-

fect health. These are the cases that probably fail to heed the warning.

After gastro-enterostomy a certain, varying amount of bile enters the stomach, the quantity usually diminishing after a few weeks. The presence of bile in the fasting stomach some time after the operation indicates either a defective, too small, efferent opening, or spur formation on the posterior wall of the gut, or interference with the *vis a tergo* due to twisting of the proximal jejunum on its long axis, or to too long a loop or to some other error in the technique of the operation.

One word as to spur formation, just mentioned, and which may perhaps be not quite clear. In applying the first suture of the intestine to the stomach it is essential that the line be made exactly opposite the mesenteric attachment of the bowel, otherwise the posterior wall of the gut will be drawn up and the bile instead of flowing over an even path would have to travel over the convexity or spur thus formed, and since a fluid naturally seeks the path of least resistance, too much of the bile will flow into the stomach.

Ulcers at the pylorus, the most common site of peptic ulcer, will in a large percentage of cases demand pylorectomy, since the lumen of the stomach at this point is not large enough to permit excision alone, unless the resulting opening is so small that its closure will not interfere with the lumen.

The most favorable ulcers for excision are those on the walls of the stomach and small ulcers on the lesser curvature. In excising an ulcer on the lesser curvature it is best to close the wound in a direction opposite to that in which it was made; for example, if the opening is made crosswise, it should be closed lengthwise. This not only does not interfere with, that is diminish, the lumen, but if anything, makes it larger at the point of suture.

When the ulcer on the lesser curvature is comparatively near the pylorus and there is considerable induration, subtotal gastrectomy is indicated, and of course posterior gastro-enterostomy.

Large callous ulcer located to the middle or to the left of the median line of the lesser curvature, with extensive induration involving the walls of the stomach are best treated

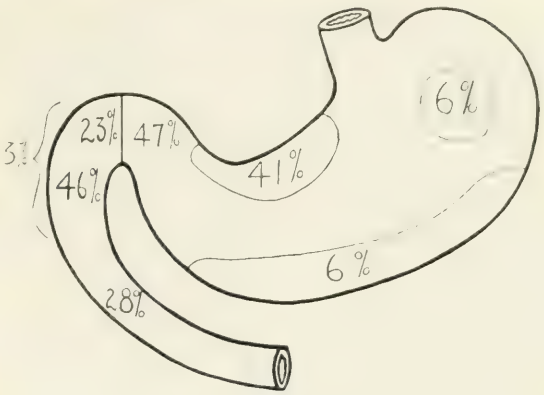

Fig. 4. Location of ulcers.

by circular resection, and end-to-end anastomosis with posterior gastro-enterostomy to the pyloric side of the line of suture. Formerly I did not always make the anastomosis, but since I have adopted the procedure I have applied it many times with most satisfactory results. Ulcers on the anterior wall can be excised and the opening closed. This also holds true with regard to ulcer on the posterior wall. The question of gastro-enterostomy will depend on the degree of acidity before operation and upon the custom of the individual operator, based upon wide experience which enables him to arrive at a quick decision suitable to each case.

Ulcers on the posterior wall can usually be excised by making an opening in the anterior wall of the stomach (gastrotomy) and dealing with the ulcer through the cavity. After closing the anterior wall, the suture can be reinforced by entering the lesser peritoneal cavity through the gastrohepatic or gastrocolic omentum or through the intercolo-epiploic route. When the ulcer on the posterior wall is close to or adherent to the pancreas it is best attacked by an approach through the lesser peritoneal cavity by way of the gastrohepatic omentum or one of the other routes just mentioned. The separation of an ulcer adherent to the pancreas is most advantageously made with the cautery knife. In order to avoid the re-formation of adhesions after the operation, William J. Mayo has devised an ingenious scheme; after the ulcer is excised and the opening closed he

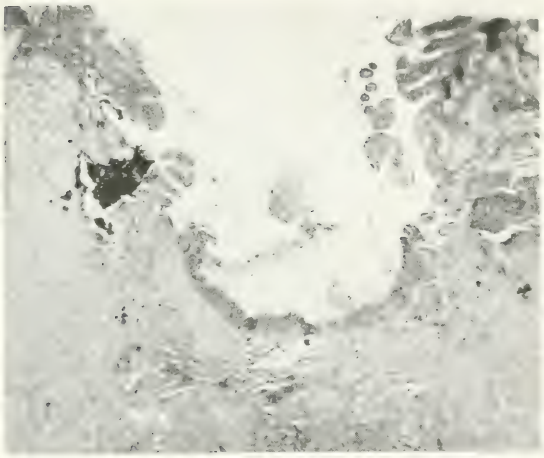

Fig. 5. Duodenal ulcer. Acute. Base in submucosa, with narrow rim of necrotic tissue.

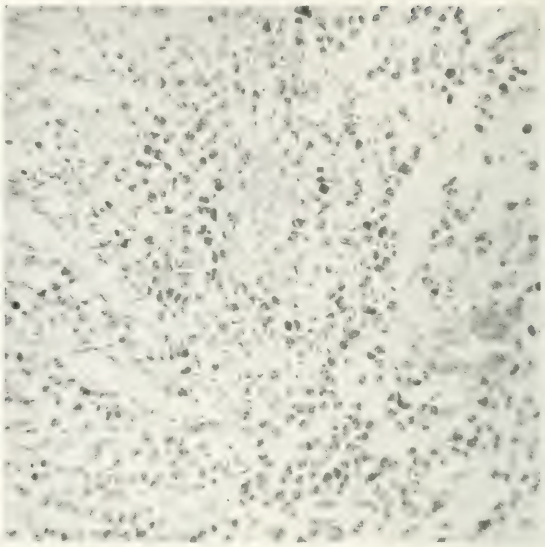

Fig. 6. Acute inflammatory reaction in submucosa under the ulcer base.

brings up the free border of the great omentum through an opening in the gastrocolic omentum, carrying it up between the stomach and the pancreas and implanting it over the site of the line of suture.

In the treatment of duodenal ulcers we cannot be quite so free with our radicalism except when the site of the ulcer is the first portion of the duodenum. The operation of choice for an ulcer at this site with widespread induration is pylorectomy. But if the ulcer is a small one excision will suffice. Ulcer in the second portion of the duodenum is a different proposition. If located on the inner pancreatic wall, it will rarely require more than a posterior gastro-enterostomy. If on the outer or external wall, excision or infolding of the ulcer may be feasible. But oftentimes this cannot be done on account of its close proximity to the entrace of the common duct. In such cases posterior gastro-enterostomy is indicated.

As I have indicated at the outset, by surgical treatment I am able to report 90 per cent of cures in cases that were traced.

Not only does surgery afford physical relief, but it also gives mental relief by removing the constant fear of a return of the trouble, and the economical loss entailed by renewed treatment.

This discussion would, of course, not be complete without considering the uncured cases. The usual 2 per cent of marginal ulcers were encountered in the series; not all of them, however, had been originally operated upon by me. The technique of the original operation plays a very important rôle in the incidence of marginal ulcer and while I could have much to say with respect to this, it would hardly be of interest to this body of medical men whom I have the pleasure of addressing this evening. Other elements enter into the question of the case not benefited by surgery, such as individual disposition, nervousness, and the like; and I am convinced that these cases, although they may be temporarily benefited psychologically as well as physically by medical methods, they will not be permanently benefited by any treatment, no matter how refined, except probably by operation.

PATHOLOGY

The pathological study of these ulcers is based on 143 specimens, 48 from the stomach, and 95 from the duodenum. They were received in the routine way from the operating-room, described, portions chosen for section, fixed in 4 per cent formaldehyde, and histological preparations made, and stained with hæmatoxylin-eosin.

Fig. 7. The overhanging edge.

Fig. 8. Chronic duodenal ulcer.

It is recognized that comprehensive descriptions of the pathological anatomy have been published from time to time since the days of Cruveilhier (1), and even before. Rokitansky (2), Virchow (3), and a host of later authors, from time to time, contributed a share toward the facts of this disease. Rokitansky, for example, gives very wonderful descriptions of gastric ulcers, describing their pathological anatomy, their situation, their tendency to perforate and to cause hæmorrhages; and also calls attention to the origin of carcinoma from them. Bamberger theorizes as to their mode of formation, suggesting explanations which still have adherents at the present day.

The present study does not throw any light upon any of the fundamental problems involved, but it serves a useful purpose in conjunction with the clinical remarks of Dr. Deaver. It shows that these ulcers were typical of those described in the literature, and among them were met practically all the complications and sequelæ of which we are accustomed to think.

Twenty-one of the total number occurred in females, and 122 in males, a proportion of 1: 6. This is unusual. Statistics, however, of various authors vary greatly; and too much importance cannot be attached to individual reports. Considered generally, the proportions are possibly slightly more males than females.

In all except five, there was only one ulcer; two were present in three, and three ulcers present in two specimens. Two of those containing multiple ulcers were from the duodenum.

The extremes of size of the ulcers were from one-half millimeter to 10 centimeters in diameter. The actual ulceration variously involved mucosa, submucosa, muscularis, and peritoneum. The majority had as a base what would correspond to the inner layer of the muscularis. The general shape was rounded or oval. In five specimens, a serpiginous type was present, and it seemed likely in at least three of these, that there had been several ulcers which had coalesced. (Photographs of paintings of several of these gross specimens are shown in Figures 1, 2 and 3.) Specimens from the duodenum showed a less proportionate number having the typical punched out appearance and extensive fibrosis than those from the stomach. Dr. Deaver comments that he met frequent typical old calloused ulcers in the duodenum lower down in that viscus in a position where excision was not feasible, and hence, these specimens were not examined pathologically.

The location of these ulcers is depicted in the diagram; those in the stomach and those

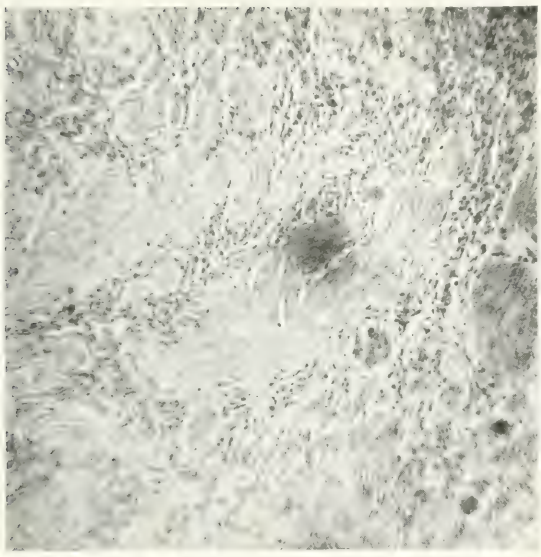

Fig. 9. Scar tissue and cellular infiltration in muscularis.

Fig. 10. Œdema of muscularis in an acute exacerbation.

in the duodenum being expressed as separate percentages (Fig. 4). The figures are compiled from the total number met at the operating table; and thus a larger total than were removed and examined pathologically are included.

For purposes of discussion, the ulcers have been divided roughly into acute, of which there were 5 in the stomach and 17 in the duodenum; and chronic, of which there were 29 in the stomach and 62 in the duodenum. A general description on which this classification is based is as follows:

The acute variety showed ulceration extending in the majority of cases through the mucosa, and part way through the submucosa. The area was typically rounded, from 1 to 10 millimeters in diameter with intensely congested base and surrounding tissue. Peritoneal involvement in the deeper ones was shown by congestion and a flake or two of fibrin. Histologically, intense active congestion of the bases and edges was seen with a small rim of necrotic tissue as an immediate base. The neighboring parts showed more or less œdema, cellular infiltration, and perhaps the first beginning of repair (Figs. 5 and 6). A very remarkable type was seen in 21 instances. The ordinary evidences of inflammation and repair in these were entirely absent, and it seemed as though a portion of the stomach or the duodenal wall had been gouged out quite clean by some instrument, and that no inflammatory reaction of any kind had taken place. This process, histologically, was nothing more or less than necrosis of the involved part.

The chronic ulcers showed the classic crater-like appearance with rolled-in, overhanging edges (Figs. 7 and 8). Scar tissue hardened the edges and base, and more or less congestion and punctate hæmorrhagic spots influenced the color. The indurated area and the congestion faded out into the surrounding tissue to a greater or less distance. The bases were covered with a thin layer of dirty necrotic material. When this was wiped off, an indolent, easily bleeding, ragged granulation tissue showed. The peritoneal coat was often thickened, ragged where adhesions were separated, and lymph nodes in the neighborhood were enlarged, hard, and fibrous (Fig. 1). Histologically, the bases and edges were formed of old scar tissue, liberally sprinkled with lymphocytes, and the edges covered by more or less degenerated mucosa. Little tendency toward active healing was evident. The scar tissue and cellular infiltration extended into the muscular coats in advance of the necrotic process, and infiltrated between muscle bundles laterally and downward (Fig. 9).

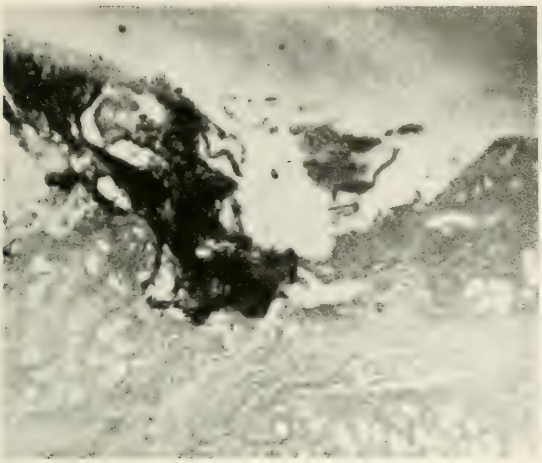

Fig. 11. Ulceration in an apparently healed ulcer.

Fig. 12. Beginning carcinoma in the edge of an ulcer.

An acute exacerbation was evidenced grossly by much more decided congestion, swelling, and œdema, giving the ulcer, especially its edges, a puffy appearance and a more boggy sensation to the touch. The base was more ragged and more swollen and the zone of reaction in the neighborhood was more intense and wider. Such an acute exacerbation with swelling and œdema was apparently the cause of an acute pyloric obstruction manifested by violent uncontrollable vomiting in a patient who had had symptoms of gastric ulcer for a number of years (Fig. 10). Histologically, it can be shown in these ulcers that this more active process is not associated with attempts at repair. Necrosis is extending in the edges and base. Numerous pus cells, plasma cells, and eosinophiles are scattered throughout, and œdema and cellular infiltration penetrate beyond the region of old scar tissue, that is, beyond the edge of reaction of the old ulcer. This occurred in 14 ulcers of the stomach and in 16 of the duodenum.

The question of repair of these ulcers is still a debatable one. The fact that in the clinical manifestations of the disease relapses and recurrences of symptoms occur even after long intervals, adds much to the difficulties of certain decision. An ulcer may heal and symptoms disappear, but when the symptoms recur, it is impossible to say whether it is the same old ulcer or a new one. Figure 11 is a photograph of a section of a duodenal ulcer from an individual who was operated upon in an interval so to speak, between attacks. At the operation, a scar was found and it was thought that it was a healed ulcer. Pathologically, as the photograph shows, the ulcerative process is still present. In those remarkable instances where no inflammation about the ulcer was found, no signs whatever of repair could be seen. They have been classed as acute ulcers. Histories are more or less unreliable, and pathologically, nothing more definite can be said of the duration of the process.

Depending on the viewpoint and the criteria chosen, the incidence of carcinoma arising from ulcers varies in published reports from 5 or 6 to 70 per cent. It can safely be said that carcinomata do arise from gastric ulcers, and whether the percentage be high or low, the fact is a most important one for clinical use. Ewing (4) has discussed the criteria upon which the diagnosis of carcinoma following ulcer can be based. With these in mind, the last 100 specimens of gastric carcinomata removed surgically have been reviewed. In the history of these patients the special point of duration of symptoms has been noted. Many of these patients gave the history of repeated attacks referable to the stomach, with subsequent recovery, more or less com-

Fig. 13. Beginning carcinoma in the edge of an ulcer.

Fig. 14. Beginning carcinoma in the edge of an ulcer.

plete, and then finally, one attack which grew steadily worse until operation revealed a carcinoma. With these histories and the appearance of the specimen both grossly and microscopically, the percentage of carcinomata arising from the old ulcers in this series must be placed at about 38 per cent. Figures 12, 13, 14 are photographs under different magnifications, of a specimen in which the carcinomatous change was found at one point on the edge of a chronic ulcer.

In three instances, portions of the stomach were removed and the pathological diagnosis of simple ulcer made. The patients returned with obvious gastric carcinomata. More sections of the old specimen revealed an early carcinoma in one of these cases, but serial sections, fairly complete, failed in the other two. It must be emphasized that sections from four or five different regions may be necessary to detect a beginning carcinoma. The older tumors are usually easily recognized.

Accessory pancreas was met in two instances. In one, a very small island of pancreatic tissue was imbedded in the muscularis immediately under a small duodenal ulcer. To the other case, more interest attaches. The patient, a man 56 years old, was operated upon for intense symptoms referable to the right hypochondrium. A mass was excised from the right wall of the duodenum and acute and chronic ulceration was found extending to submucosa. Frozen section revealed pancreatic tissue. On receiving this report, Dr. Deaver examined the pancreas proper to find a connection. It was entirely separate. The patient, according to his family physician, had had diabetes mellitus for many years. His condition after operation was unsatisfactory, and he died in coma on the sixth day. Autopsy permission was not granted. Serial sections failed to reveal a typical island of Langerhans, but ducts were abundant and several opened at the base of the ulcer. It is tempting to ascribe the presence of ulcer in this case to pancreatic juice, but while ducts were present and many acini contained zymogen, it can never be known that actual pancreatic juice was secreted by this nodule. Investigation of the condition of the islands of Langerhans in the pancreas itself was much desired, but could not be done.

Finally, a few comments on the laboratory examinations as diagnostic helps may be appended. In the ordinary routine, the following tests were performed: urinalysis, blood counts, gastric contents analyses following test meals, full meals and fractionation, and stools. In summary, the laboratory findings have varied according to the position of the ulcer, the stage of the disease and complications, such as pyloric obstruction, bleeding, etc. Hyperacidity was by no means constant. The discovery of blood in the gastric contents, either grossly or microscopically, was of considerable value. When present as occult blood, its significance was more doubtful. The laboratory findings as a whole have been recognized as a help, to be interpreted with great care, of great value in certain types of cases, and of little value in others. Misleading results were frequent, unless the particular picture of the particular case was constantly kept in mind.

CONCLUSIONS

In conclusion, from the pathological standpoint, two points have been particularly impressive.

1. The necessity of a careful analysis of the clinicopathological findings as diagnostic helps in the light of the conditions found in each individual case.

2. The importance of a very careful gross examination and subsequent judicious choice of several blocks of tissue for section to exclude carcinoma.

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THE DIAGNOSIS AND TREATMENT OF HYDROCEPHALUS DUE TO OCCLUSIONS OF THE FORAMINA OF MAGENDIE AND LUSCHKA

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EVERY case of hydrocephalus has a specific cause which can and should be located by clinical tests during life. In a great many instances this cause is easy of correction by operation with a resultant cure of the disease. I realize that this is a very sweeping statement concerning a disease which has been considered idiopathic and for which no treatment has been successful. The purpose of this paper is to describe a group of cases of hydrocephalus caused by closure of the foramina of Luschka and Magendie, to show the pathology by postmortem specimens, to describe the means by which it can be diagnosed clinically, and particularly to describe an operative procedure which will produce its cure. In previous papers,[1] I have described the pathology, methods of diagnosis, and operative procedures for the treatment of other types of hydrocephalus. In this type of hydrocephalus, the treatment is ideal in that the cause can be attacked directly and with every prospect of permanency. It is one of the most common of the types of congenital hydrocephalus, being surpassed in frequency probably only by the group of cases with an obstruction at the aqueduct of Sylvius. To be effective, the treatment must be applied in the early stages of the disease.

A clear conception of the anatomy of the cerebrospinal spaces, within and without the brain, is an absolute prerequisite to the introduction of a successful method of treatment. It must be appreciated that the normal equilibrium of cerebrospinal fluid is absolutely dependent upon communication between the ventricles of the brain and the subarachnoid spaces. In the ventricles, cerebrofluid is produced; in the subarachnoid space, it is absorbed. The balance between the formation and the absorption of cerebrospinal fluid is maintained solely by three openings which connect the fourth ventricle with the cisterna magna. These openings are the paired foramina of Luschka and the median foramen of Magendie. These openings are neither myths nor artefacts. Although they are now incorporated in the modern text books of anatomy, there is a very uncertain attitude toward their acceptance by many authorities, both anatomical and surgical, and their demonstration is usually even more indefinite. By many, they are looked upon as "functional" rather than anatomical openings. There can be no reason for this hesitancy in their acceptance and no basis for a controversy as to their exact nature. They are just as definite and as precisely outlined as the foramen of Monro or the aqueduct of Sylvius. Nor is this an academic discussion. It is one of the greatest practical import, for surely no neurological surgeon can be competent to make a differential diagnosis of lesions of the cerebellar region, and far less to perform cerebellar operations, who has not a perfect understanding of the importance of the foramen of Magendie and who does not know the foramen when he sees it and who does not expose it at every cerebellar operation in which the exploration has not disclosed the lesion. To those who do not question the existence of the foramen of Magendie, these statements, doubtless, seem superfluous, but constantly the question is asked by men of authority: Is the foramen of Magendie a real opening, or is it not an artefact produced by dissection of the delicate membranes? The answers to this query are many and admit of no equivocation.

An anatomical dissection after death shows the three foramina, through each of which a probe can easily be passed without injury to any membranes. The foramen of Magendie is exposed at most cerebellar operations and

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through it the floor of the fourth ventricle is always evident. The three openings can easily be demonstrated at a postmortem examination (without any dissection) by cutting the mid-brain transversely and injecting (without pressure) into the aqueduct of Sylvius a colored solution; the color will pass from the fourth ventricle to the exterior through the foramina of Luschka and Magendie, but through no other openings.

ARE THE FORAMINA OF LUSCHKA AND MAGENDIE NECESSARY?

The whole problem of hydrocephalus hinges on this question. As early as 1790, the renowned anatomist, Monro, the discoverer of the foramen of Monro, denied any communication between the ventricles and the subarachnoid space. A curious defect in his argument was that, in a case of hydrocephalus, there were no openings and the ventricular system was intact. So it was in his case, for he missed the cause of the hydrocephalus—the closure of the foramina at the base. Magendie described the foramen which bears his name, in 1825. It seems incredible that, at this late date, a large part of his epoch-making contribution should have been devoted to proving that the cerebrospinal system contained fluid and not air or vapor. His foramen of Magendie was received with skepticism and open hostility. Renault, 1829, found the foramen of Magendie absent in the horse and dog, and his observations were even confirmed by Magendie, though the latter still thought his foramen important in man. Magendie's explanation of the function of the foramen was not impressive and was incorrect in the light of our present knowledge. He assumed the cerebrospinal fluid to form in the pia and thought it passed upward through his new foramen into the ventricles of the brain. And when he found a case of hydrocephalus (1842) in which the foramen of Magendie was closed, a satisfactory explanation was not forthcoming, though he still thought in some way the closure of the foramen to be the cause of the disease, as it undoubtedly was. Monro had the cause of hydrocephalus before him, but missed it because of his eagerness to prove a theory. Magendie maintained confidence in his anatomical findings, in spite of the conflict with his theories, and should receive credit for the first case of hydrocephalus in which the described pathological findings were the cause of the disease.

Krause (1843) and Todd (1847) described the foramen of Magendie as an artefact produced either by pressure or tearing of the tissues. Virchow (1854) very strongly disclaimed the existence of a foramen of Magendie or any other open communication between the ventricles and the subarachnoid space. With Virchow's strong opposition it is but natural that Magendie's foramen should by that time have been thoroughly discredited. But another discovery of the greatest importance appeared in the same year as Virchow's publication, and gradually the prevailing but erroneous views have been transformed. Luschka discovered a foramen on each side of the fourth ventricle at the point of emergence of the flocculus from the fourth ventricle. He also confirmed Magendie's discovery of a mesial foramen, thus making three foramina which established communication between the ventricles and the subarachnoid space (the cisterna magna). The foramina of Luschka were found to be constantly present in man and all mammals. The absence of the foramen of Magendie in the horse and dog is immaterial because the two foramina of Luschka are ample to assume its function. Nature has made in man the foramen of Magendie as an additional safeguard against possible closure of the fourth ventricle; this is in marked contrast to the absence of such safeguards in case of closure of the aqueduct of Sylvius. Key and Retzius (1875) and Retzius (1896) confirmed the presence of the foramina of Luschka in examinations of many brains. They found the foramen of Magendie absent in two of one hundred cases examined and the foramina of Luschka closed in three instances. No mention is made whether the three foramina were absent in the same brains, nor of the incidence of hydrocephalus in the brains examined. Cannieu (1898), however, made similar examinations and looked upon all the openings as artefacts and considered the ventricles a closed system and everywhere lined by

epithelium. Testut and Schmorl, also, shared this view.

In recent communications[1,2] I have shown the absolute necessity of communication between the ventricles and the subarachnoid space. I have shown by experiments on animals that cerebrospinal fluid is formed from the choroid plexus which are located in each of the four ventricles, and that in no part of the entire ventricular system is there any appreciable absorption. It is for these reasons that the foramina of Luschka and Magendie are necessary. They permit the fluid to pass to the absorbing area of the brain—the subarachnoid space. The normal ventricular pathway for cerebrospinal fluid is from each lateral ventricle through its foramen of Monro into the third ventricle, thence through the aqueduct of Sylvius into the fourth ventricle and from there into the cisterna magna through the foramina of Magendie and Luschka. There are no other openings which allow communication between the ventricles and the subarachnoid space; all other openings which have been described are artefacts; nor has it been possible to establish artificial openings in other parts of the brain to replace these openings when they become closed, except by the operation which will be proposed; here alone, the anatomical conditions are such as to favor the restoration of these openings.

From another viewpoint, the foramina of Luschka and Magendie can be shown to be indispensable. Closure of these three foramina in the same brain will, without exception, result in hydrocephalus. This we have shown experimentally by producing hydrocephalus in dogs; and clinically it has been observed in a number of patients, in many of whom postmortem examinations have been made.

It is entirely possible, in fact it frequently happens, that one or even two of the three foramina at the base may be occluded and the remaining opening is adequate to allow the ventricular fluid to pass from the ventricles into the subarachnoid space. On the other hand, it does not mean that if one, or even all, of these foramina are open, hydrocephalus may not result. In the communicating type of hydrocephalus precisely this condition is present, but the hydrocephalus is due to an entirely different cause—the obliteration of the cisternæ or their branches. The inflammatory process which seals the cisternæ or their branches usually obliterates one or two of the three foramina, though not infrequently all three openings are closed, in which case the hydrocephalus becomes obstructive.

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THE PATHOLOGY OF OCCLUSIONS OF THE FORAMINA OF MAGENDIE AND LUSCHKA

There are, apparently, two types of occlusions of the foramina of Luschka and Magendie: One which occurs congenitally and is well advanced at birth, the second which occurs at all ages. The latter always follows some form of meningitis; the former may or may not be the result of an intra-uterine inflammation.

In the cases which are apparently of congenital origin, the characteristic large head of hydrocephalus is usually noticed about the second or third month, though, of course, the brain is largely destroyed by this time, showing that the disease has existed for a long time,—undoubtedly far back into intrauterine life. I have seen four of these cases at postmortem examination; in all, the time of recognition of the hydrocephalus was approximately the same and, therefore, doubtless the disease arose at about the same period of fœtal life. In each of these cases, the aqueduct of Sylvius was treble its normal size, the fourth ventricle greatly enlarged, though there was great difference in the actual size of the fourth ventricle and the shape and size of the cerebellum. In two cases, the vermis was absent (Figs. 2 and 3), the two lateral lobes of the cerebellum were small nubbins, laterally placed in the angles of the posterior cranial fossæ and connected by a broad expanse of a rather thin, transparent membrane which, in the absence of the vermis, was now the roof of the fourth ventricle. This membrane was fastened tightly to the lateral margins of the medulla and pons and

everywhere the fourth ventricle was hermetically sealed, giving it the appearance of a huge cyst. This cyst was not adherent to the dura and there were no signs of any pre-existing inflammatory process in the posterior cranial fossa. The third and fourth cases differed from this description only in degree; in each the vermis was present, the fourth ventricle was a large cyst everywhere covered by cerebellum and hermetically sealed. One lateral pouch (lateral recess) was very transparent and extremely thin, but everywhere intact; this pouch was really a secondary bulging cyst which had protruded through a ring of denser tissue which corresponded with foramen of Luschka. In these cases no traces of a pre-existing meningitis were seen.

Recently, in all postmortem examinations of cases of hydrocephalus, we have injected a colored solution into the spinal canal to observe its distribution in the subarachnoid space and in the ventricles. In two of these cases (with occlusion of the basal foramina) the solution surrounded the entire brain but did not enter the large dilated fourth ventricle, proving conclusively that the obstruction was complete and the fourth ventricle, therefore, devoid of all communication with the subarachnoid space. One can pass a probe into the regions in which the foramina are normally present and one meets a bulging but closed pouch instead of the usual normal opening. Again, colored solutions injected into the fourth ventricle fail to reach the exterior as in the normal brain. If one holds the specimen before a light and looks through the enlarged aqueduct of Sylvius into the fourth ventricle, the transparent membrane can be beautifully seen surrounding the margins of the medulla and pons and stretching upward across a space about 1 centimeter wide before attaching itself to the inferior margin of the cerebellum. If the brain is carefully removed, the arachnoid membrane, which forms the outer layer of the cisterna magna, can be dissected from the base of the brain, exposing the cystic membrane which forms the sides of the fourth ventricle and is entirely distinct from the pia-arachnoid. The presence of this delicate arachnoid tissue, not adherent or only slightly adherent to the contiguous brain tissue, may be looked upon as evidence against an old inflammatory process, at least of a severe grade.

Fig. 1. Photographs of infant of 3 months with hydrocephalus. A thoracic meningocele doubtless makes the cause of the hydrocephalus and the meningocele the same, i.e., an intra-uterine inflammatory process. At operation an inflammatory process was found to have occluded the foramen of Magendie and a large fourth ventricle resulted. The black lines on the head show the limits of the fontanelles.

We know that the foramina of Magendie and Luschka are secondary openings in a primary, closed, ventricular system. Blake[1] and Heuser[2] have shown these foramina to

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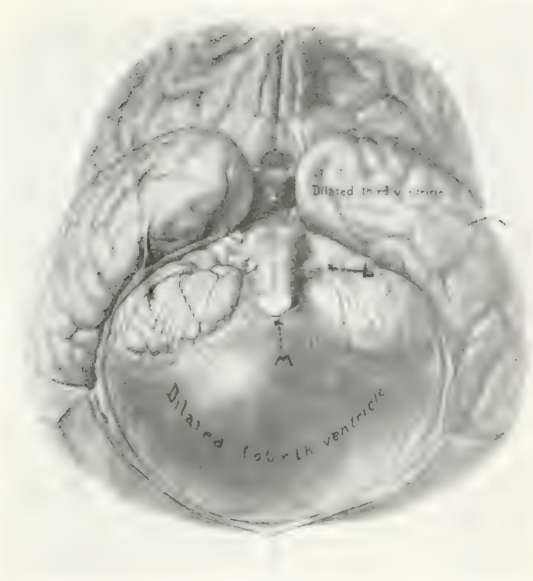

Fig. 2. Advanced hydrocephalus resulting from complete closure of the foramina of Magendie and Luschka. All the ventricles are dilated up to the point of obstruction. Owing to the absence of adhesions, to the absence of the vermis of the cerebellum, together with the presence of hydrocephalus at birth, we have looked upon the occlusion of these foramina to have been due to their failure to develop rather than to a secondary closure. *l*, Where foramen of Luschka should be; it is closed. *m*, Where foramen of Magendie should be; it is closed.

develop in the pig embryo by a gradual thinning of the wall of the ventricle. Owing to the early period of onset of the hydrocephalus *in utero*, and to the absence of adhesions, I am led to believe that this type of hydrocephalus results from the failure of these foramina to develop, rather than from a secondary closure after their development. On the other hand, the same picture may result from a very mild inflammatory process which has sealed these foramina and has left few, if any, additional traces such as adhesions in its wake. It is not impossible that some very mild type of inflammation may seal these openings, though such an explanation certainly seems less probable.

There is a second group of these occlusions of the basal foramina, which occurs in infants, in which an old inflammatory process is everywhere manifest. We have seen three cases of this kind at necropsy and one at operation. The base of the brain is then sealed to the dura, over areas of considerable extent; the meninges are thickened and tough, and the contiguous brain itself is usually thickened and rigid. The cisterna magna and the other cisternæ are usually obliterated by adhesions. The foramina of Luschka and Magendie are occluded either completely or almost completely. The floor of the fourth ventricle also shows marked evidences of the inflammation, rugæ of scar tissue are present, and the size of the medulla and pons is increased by the inflammatory tissue. Two of these cases have followed a definite meningitis. In the third case, hydrocephalus was undoubtedly present at birth; the delivery was difficult and the head was unusually large; alumbar myelomeningocele was also present. In this latter case, doubtless, an inflammation had been present early in intra-uterine life. This is evident by the presence of the meningocele and by the high grade of hydrocephalus which was manifest soon after birth. In a fourth case, a dorsal meningocele was present at birth and hydrocephalus was observed 2 months after birth. A dense scar covered the foramen of Magendie and the contiguous region. The cerebellum was firmly bound to the medulla and pons, there being no bulging fourth ventricle between. A large cerebellar hernia projected into the spinal canal. The pia-arachnoid was adherent to the dura over most of the area exposed at operation. Undoubtedly, an intra-uterine inflammatory process had produced both the hydrocephalus and the meningocele. In all of the cases with marked evidences of an old inflammatory process, there is a striking difference from those of the noninflammatory type. Following the inflammatory process, the cerebellum is usually, but not always, firmly bound to the border of the medulla and pons, thus effectually preventing the fourth ventricle from bulging as a cyst between these structures, as occurs in the noninflammatory type. The difference between a total and a partial occlusion of the foramina of Luschka and Magendie is one which is readily made at necropsy and just as easily by a clinical test, and is all-important in the matter of treatment of the individual case.

Fig. 3. Sagittal view of same brain. The entire ventricular system is dilated, the fourth ventricle particularly so. Had the obstruction been at the aqueduct of Sylvius, the fourth ventricle would not be enlarged.

A group of two adult cases completes the pathological picture of occlusions at the basal foramina. The pathology of these cases was seen at operation and not at necropsy. At operation, the foramina of Luschka can be seen directly only with difficulty, but the examination of the foramen of Magendie gives all the necessary information. If the foramen of Magendie is patent, hydrocephalus will not result even should both foramina of Luschka be closed. On the other hand, if the foramen of Magendie is closed, hydrocephalus will result only if both foramina of Luschka are also occluded. *But, given a dilated fourth ventricle and a closed foramen of Magendie, the closure of this foramen is always the cause of the hydrocephalus.* On the other hand, given a normal fourth ventricle and a closed foramen of Magendie, the closure would not be significant. The latter stipulation, however, is only of theoretical value for there would be no symptom requiring operation.

In one of the two adult cases, a dense scar at the foramen of Magendie (Fig. 7) was the only evidence of a pre-existing inflammation, but this evidence was indisputable. In this young man, who was 19 years old, the pathological features differed from those of the congenital type of occlusion of these foramina only in the presence of this scar; the cystic fourth ventricle bulged on each side between the cerebellum and medulla which were separated by the pressure of the accumulated fluid. The scarred foramen of Magendie was sufficiently extensive and rigid to retain the cerebellum in the posterior cranial chamber and prevent the protrusion of the lobes through the foramen magnum into the spinal canal (cerebellar hernia). In the second adult case, the fourth ventricle was of tremendous size and both lobes of the cerebellum had

Fig. 4. Photograph of man who has had two useless cranial operations performed. His symptoms resembled closely those of a cerebellopontine tumor. A postinflammatory occlusion of the foramina of Luschka and Magendie was found at operation and relieved by construction of a new foramen of Magendie.

herniated far into the spinal canal. The foramen of Magendie was tightly sealed by adhesions which, however, were not present over the lobes of the cerebellum. The cerebellum and medulla were also tightly adherent, thus effectually preventing the fourth ventricle from bulging between these structures. The operative findings of these two cases were almost exactly like that of the infant in whom an intra-uterine inflammation had closed the foramina of Luschka and Magendie.

To sum up the pathology of these nine cases, the fundamental features were always similar. The foramina of Luschka and Magendie were closed. The absence or presence of the vermis, the position of the cerebellar lobes, the presence or absence of the bulging fourth ventricle between the inferior surface of the cerebellum and the medulla, the presence or absence of a cerebellar hernia into the spinal canal were all dependent upon local differences in type or extent of the causative lesion and, doubtless, also upon the time at which the lesion developed. In 4 cases, the cause of hydrocephalus is presumed to be a failure of the foramina of Magendie and Luschka to develop, though a mild intra-uterine inflammation can not be excluded. In 2 cases, a definite inflammatory process in infancy caused the condition, and in a third case, a definite intra-uterine inflammation had been the cause. Two adult cases were caused by a mild meningitis which, clinically, was not recognized as such but the pathological findings needed no clinical confirmation.

THE DIAGNOSIS OF OCCLUSIONS OF THE FORAMINA OF LUSCHKA AND MAGENDIE

Since occlusions of the foramina of Luschka and Magendie occur at varying periods of life, I shall divide the consideration of the clinical manifestations and the differential diagnosis into the period of infancy and of later life. Seven of our cases occured in infancy and two in adult life. In infancy, the clinical picture is that of hydrocephalus; in adult life, the clinical picture is hard to differentiate from that of a cerebellar tumor. Infants, of course, give none of the cerebellar signs such as ataxia, adiadokokinesia, nystagmus, Romberg, and disturbances of gait; the signs are purely those of increased pressure of the intraventricular fluid and this is shown solely by enlargement of the head and separation of the sutures. At this early age, an enlargement of the head is almost pathognomonic of hydrocephalus. But, as hydrocephalus is a symptom and not a cause, there is nothing about the enlargement of the head which denotes the location of the cause, i. e., the obstruction.

There is no clinical picture which is distinctive of any particular type of hydrocephalus, at least none is recognized as yet. It is only by the tests which have been recently introduced that we are able to determine the location of the obstruction which causes the hydrocephalus. In a recent publication,[1] we have shown how lesions of the aqueduct of Sylvius may be localized. The localization of occlusions of the foramina of Magendie and Luschka is made by the same methods. It is first necessary to determine that hy-

[1] Surg., Gynec. and Obst., 1920, xxxi, 340.

Fig. 5. Front and back views of a patient cured of hydrocephalus by construction of a new foramen of Magendie. Succeeding figures give the diagnostic, operative, and postoperative story. Photograph one month after operation.

Fig. 6. Roentgenogram of the head of patient shown in Figure 5, taken before operation. The convolutional atrophy made the diagnosis of hydrocephalus.

drocephalus is not of the communicating type but is due to an obstruction in the ventricular system. This is done by the indigocarmine test; in obstructive hydrocephalus, the color does not appear in the spinal canal after its injection into a lateral ventricle. There are two locations at which the obstruction can exist: (1) the aqueduct of Sylvius or (2) the foramina of Luschka and Magendie (an obstruction at the foramen of Monro must also be thought of, but its incidence is rare). One can, at times, get a fair indication of the position of the obstruction by the amount of cerebrospinal fluid which can be obtained by lumbar puncture but, at best, such deductions are most capricious. In occlusions of the aqueduct of Sylvius, several cubic centimeters of fluid may be obtained by a simple tapping and by aspiration, whereas in occlusions of the foramina of Magendie and Luschka, usually only a few drops will be obtained and little, if any, more can be aspirated. The reason for this difference is that, in lesion of the basal foramina, the foramen magnum is well plugged by a cerebellar hernia or by the dilated ventricle without a hernia. But this differentiation is not always so simple, for at times only a small amount of fluid is obtained when the obstruction is at the aqueduct of Sylvius, owing to the foraminal herniation of the cerebellum. An absolute determination of the precise location of the obstruction can be made only by the use of ventriculography. Following a complete removal of the ventricular fluid and the substitution of air, the latter will reach the point of the obstruction but can not pass beyond. If the aqueduct of Sylvius is obstructed, the third ventricle will be clearly shown but no air will reach the fourth ventricle. If, in hydrocephalus, the fourth ventricle and aqueduct of Sylvius are filled with air, both will be enlarged and the boundaries of each will be sharply defined. Such findings will eliminate an obstruction at the aqueduct of Sylvius and place the obstruction at the foramina of Luschka and Magendie, provided, of course, an obstructive hydrocephalus has been demonstrated by the indigocarmine or phenolsulphonephthalein tests. In obstructions at the foramina of Luschka and Magendie, the air will not fill the cisterna magna, whereas in communicating hydrocephalus, the cisterna magna will not only contain air but will usually be considerably enlarged.

The clinical diagnosis of a postinflammatory occlusion of the foramina of Luschka and Magendie in adult life is more difficult. This is true mainly because the diagnosis of *hydro-*

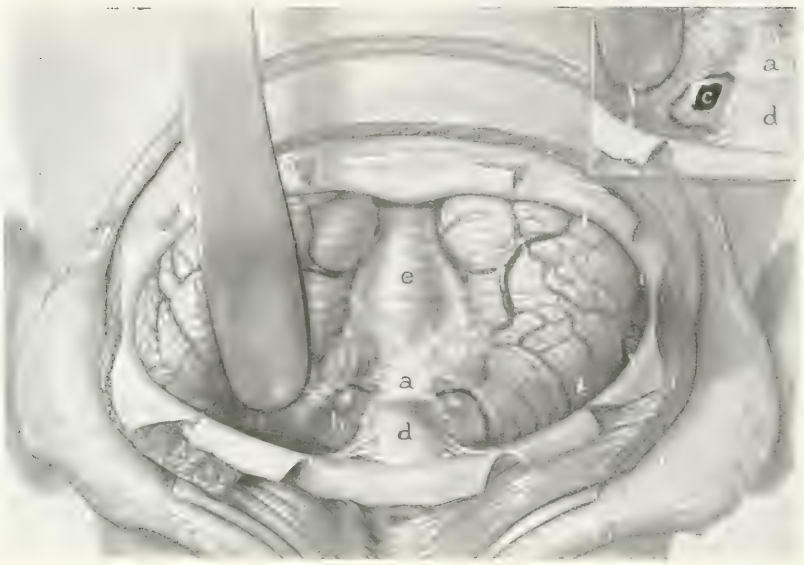

Fig. 7. Operative findings of case shown in Figures 5 and 6. Note the dense scar at *a;* the medulla *d;* the vermis *e;* with widening and flattening of the convolutions, owing to the distention of the fourth ventricle. The fourth ventricle bulges at *b* between the medulla and cerebellum because these structures are not bound by adhesions. In the insert the new opening is shown at *c;* this opening represents a newly constructed foramen of Magendie.

cephalus is more difficult and when the diagnosis of hydrocephalus is finally made, the chances are that the obstruction is due to a tumor, particularly when there has been no antecedent history of meningitis. In infants, intracranial tumors need scarcely be considered, so that the diagnosis of hydrocephalus, which is made with relative facility, presupposes an inflammatory condition or one of the congenital defects, both of which lesions are so frequent at that age.

I had never heard of an inflammatory occlusion of the foramina of Luschka and Magendie in adult life, so that the first case came as a surprise, the preoperative diagnosis of a cerebellar tumor having been made. The second case was, likewise, diagnosed a cerebellar tumor because of unilateral localizing signs and symptoms. In neither case, therefore, can we claim credit for making the clinical diagnosis. I have since seen a case which, on examination, gave almost the identical findings which were present in the second case; the diagnosis of an inflammatory occlusion of the foramina of Luschka and Magendie was considered but a cerebellopontine tumor was found. I know of no way that an obsolute diagnosis of this type of lesion can be made as yet; but it is always possible to diagnose the hydrocephalus, after which the operator must be prepared to find the lesion which is causing the obstruction and thereby producing the hydrocephalus.

The first patient with this inflammation was 18 years old (Fig. 5). He complained of general headache and loss of vision, and, at times, a staggering gait. Eight months before admission to the Johns Hopkins Hospital, the patient was seized with sudden severe headaches in the forehead and suboccipital region. These persisted, though with varying intensity. Seven months ago and one month after the onset of his illness, a sudden severe headache was quickly followed by twitching of his limbs and his right leg became paralyzed and without feeling. This paralysis lasted only a few hours and never recurred, though a similar attack a month later was accompanied by the loss of power in the right arm; this was also transient. A staggering gait was present at times, principally during exacerbations of headaches. Soon an impairment of vision was noticed in the left eye and shortly afterward in the right eye. There had been a rapid loss of sight in both eyes until there was little vision remaining in either

eye, the left being definitely worse than the right. There is complete loss of color vision and great reduction in the fields of vision; (he could not read the large headlines of a newspaper). Diplopia had been present at times. Nausea and vomiting were present only on one occasion. There was a bilateral choked disc which measured six diopters in each eye The neurological examination was strikingly negative except for a slight, even questionable, Romberg. There was no ataxia, no nystagmus, no adiadokokinesia, no extraocular palsy and the gait was entirely normal during several examinations. There was no difference in the reflexes on the two sides. Aside from the uncertain Romberg, there was only one localizing sign which could be made out objectively and that was a convolutional atrophy of the skull (Fig. 6). This roentgenographic finding is almost pathognomonic of hydrocephalus and, therefore, referred the lesion to the posterior cranial fossa. At operation, the hydrocephalus was found to be due to a dense scar at the foramen of Magendie (Fig. 7).

After operation we inquired into the past history very closely for an illness which could have been responsible for the production of this scar. There was never an illness which at all resembled meningitis, but the mother regarded his present illness as a sequel to an attack of "measles" which antedated his present cranial symptoms by four months. She had even volunteered this when the history was taken before the operation but his recovery from the attack seemed complete and there was a four months' interval of practically normal health. This illness was probably measles; there was an epidemic; a rash, photophobia, and fever were present; he was confined to bed 5 or 6 days. There had been no headaches, cervical rigidity or pains in the legs or back during the illness

The second case was a man of 36 (Fig. 4) who had wandered about from physician to physician looking for relief from terrific headaches and dizziness. Two, not only futile but injurious operations, had been performed by well meaning but thoroughly incompetent surgeons. His illness dated back 4 years when, without warning, he suddenly fell unconscious. Previous to this time he had had only occasional headaches but since then the pain never remitted. Nearly every morning and frequently during the day, vomiting accompanied the headaches and the patient was soon too weak to continue his work. Although he never fell, there was always a feeling as though he would "topple forward on his head." After these symptoms had persisted for a year there was a sudden and unexplained cessation of all symptoms for nearly a year. Then the headaches, dizziness, and vomiting again returned as before but with even greater violence. Vertigo was increased by any change of position or by lying on the back. The headache was then always present and was both frontal and suboccipital.

Bilateral decompressions, previously performed, were bulging knots. The following positive neurological signs were obtained: (1) Nystagmus in all directions; (2) slight weakness of the left external rectus muscle (sixth nerve); (3) jaw deviates to left (fifth nerve); (4) hyperæsthesia to pain, touch, and temperature, on left diminution of left corneal reflex (left fifth nerve); (5) Romberg positive, but patient tends to fall in every direction; (6) complete nerve deafness (left eighth nerve) but patient says he has been deaf in this ear since childhood; (7) slight ataxia in left hand; (8) convolutional atrophy of the skull and destruction of the posterior clinoid process (X-ray); (9) bilateral choked disc; (10) slight left fascial weakness (seventh nerve).

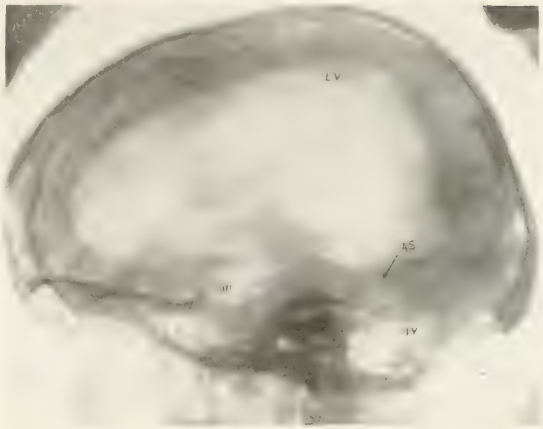

Fig. 8. Ventriculogram of same patient, 6 weeks after the operation. The new foramen of Magendie is marked by the two silver clips in the lower right hand corner of the roentgenogram (under *IV*). The lateral ventricle, the third ventricle, fourth ventricle, aqueduct of Sylvius and cisterna magna are clearly shown; but, most important, the numerous wavy lines throughout the picture are the cerebral sulci. Since air now passes into the cisterna magna and the cerebral sulci, absolute and graphic proof is given that the newly made foramen of Magendie is functioning perfectly. *lv*, Lateral ventricle, *III*, third ventricle, *as* aqueduct of Sylvius, *IV*, fourth ventricle, *c* cisterna magna. With the exception of the dotted line, which marks the outer border of the cisterna magna, the photograph of the ventriculogram has not been retouched.

The diagnosis of hydrocephalus was clear, but the unilateral weakness of the left face and loss of sensation in the left trigeminal area, loss of the left corneal reflex, weakness of the muscles supplied by the left trigeminal nerve led me to the diagnosis of a left cerebellar tumor and possibly one in the left cerebellopontine angle. A completely occluded foramen of Magendie and a greatly dilated fourth ventricle made the diagnosis at operation. Doubtless, the unilateral signs and symptoms were due to the pressure of fluid in the left lateral recess of the fourth ventricle.

After carefully examining the clinical findings in these two adult cases, I am forced to the conclusion that without a history of an

antecedent meningitis, there could be little certainty in making a diagnosis of occlusion of the foramina of Luschka and Magendie before operation. Of probably the greatest significance is the absence or the relatively slight intensity of the usual signs which are present in cerebellar lesions, such as ataxia, nystagmus, staggering gait and Romberg. In the second case, the complete cessation of all symptoms for a year is suggestive of such a lesion rather than a neoplasm.

The diagnosis of hydrocephalus can frequently be made in the later stages from the roentgenogram but in the early or moderately advanced stages of the disease the diagnosis can only be made by ventriculography. The methods of arriving at the diagnosis are essentially the same in infants and in adults. The diagnosis of hydrocephalus is all-important. The precise localization of the cause of the hydrocephalus before operation is not indispensable, for the same operative approach is necessary for obstructions at the foramina of Luschka and Magendie or the aqueduct of Sylvius. But if a hydrocephalus is proved, it is absolutely required of the surgeon that this obstruction be found at operation and of the findings there can be no equivocation.

Several years ago, I described with Dr. Blackfan occlusion of the foramina of Luschka and Magendie in an infant with hydrocephalus, but, so far as I am aware, this case and those which I have described here are the only instances of this lesion in the literature. I am confident none has been found at operation.

THE TREATMENT OF OCCLUSIONS OF THE FORAMINA OF LUSCHKA AND MAGENDIE

It is obvious that the only satisfactory treatment of any form of hydrocephalus is the treatment of the cause. In occlusions of the foramina of Luschka and Magendie, the entire ventricular system is devoid of any communication with the subarachnoid space and to cure the hydrocephalus it is necessary to make one opening between the fourth ventricle and the cisterna magna to assume the function of the three which are blocked. But before operating it is necessary to know whether the ultimate radicles of the subarachnoid space are open and whether there is a normal absorption of fluid from the subarachnoid space. Following meningitis, particularly in children, the cisternæ are blocked as well as the foramina of Luschka and Magendie, so that the reconstruction of a new foramen of Magendie would lead to no beneficial results because the ventricular fluid would have access to only the restricted area of the subarachnoid space posterior to tentorium cerebelli. The subarachnoid space should be tested in one of two ways, first by the intraspinous phenolsulphonephthalein test and second by an intraspinous injection of air. If over 30 per cent of the phenolsulphonephthalein is absorbed in 2 hours, a cure can be expected if the cause is corrected. Intraspinous injections of air will give the same information. The air will reach all the parts of the subarachnoid space which are open. If, therefore, the cerebral sulci show in the roentgenogram, there is a graphic demonstration that the absorbing spaces are open to the reception of fluid if its escape from the ventricles is made possible. The absence of air in the cerebral sulci denotes a closure of the cisternæ and precludes an operative cure of the hydrocephalus. Such a finding would be accompanied by a low phenolsulphonephthalein output, usually less than 10 per cent in 2 hours.

PRODUCTION OF A NEW FORAMEN OF MAGENDIE AT OPERATION

The usual bilateral exposure of the cerebellum is made exactly as is done for the extirpation of cerebellar tumors. The operator will quickly learn to recognize the normal foramen of Magendie at a glance and to know whether it is open or closed. I rarely expose the cerebellum without seeing the foramen of Magendie, either because it is necessary to look for it or because after the removal of a tumor from this region, it is usually brought directly into view. It will probably occur to the reader to ask why it is not necessary to expose and determine the patency of the foramina of Luschka. The exposure of these openings is possible but much more difficult and not important. It is necessary to have but one of the three

foramina patent and, if the foramen of Magendie is open, it is not necessary to search further. If the foramen of Magendie is occluded the size of the fourth ventricle will indicate the condition of the foramina of Luschka.

I have operated upon three cases in which a total occlusion of the foramen of Magendie has been found. The findings in each were quite different. In an infant of 3 months, the vermis was entirely absent and the lateral lobes of the cerebellum pushed lateralward into the outer angles of the posterior cranial fossa; the remainder of this fossa was filled with the tremendously dilated fourth ventricle covered only by a membrane. The hydrocephalus was extreme, so that puncture of the ventricle quickly resulted in death. The lesion disclosed at operation in the boy of 19 was sharply localized to the foramen of Magendie and the immediately contiguous region to either side. A very dense scar (Fig. 7) bound the cerebellum and medulla and, because of its rigidity, precluded a herniation of the lateral lobes into the spinal canal. To either side of the scar, the tissues were normal. A thin, bluish wall bulged between the cerebellum and medulla and, because of its thinness, offered an ideal situation for the construction of a new foramen (Fig. 7). The absence of any signs of an old inflammatory process in this region seemed to preclude a closure of the newly made foramen, especially in view of the steady flow of cerebrospinal fluid through it into the cisterna magna. In the second case, the procedure was different, the medulla was closely applied to the cerebellum preventing the fourth ventricle bulging between these strictures as in the preceding case. It was, therefore, impossible to reconstruct a new foramen of Magendie in the space between the medulla and cerebellum, as in the other case, with any prospect of maintaining a permanent opening. The scar at the foramen of Magendie was much more localized and was confined almost to the normal limits of the foramen of Magendie. A large bilateral cerebellar hernia into the spinal canal made the exposure of the scarred foramen of Magendie difficult. To construct a new foramen, it was necessary to excise the entire scar at the foramen of Magendie. The recurrence of the scar in this case remains a possibility; in the preceding case, recurrence seems impossible.

POSTOPERATIVE COURSE AFTER CONSTRUCTION OF A NEW FORAMEN OF MAGENDIE

Each of the adult cases left the hospital a month after operation, apparently perfectly well. The boy of 19 has since resumed his studies at college. Every symptom has been completely relieved. His vision has greatly improved, both in range and acuity. Color vision, which before operation was entirely gone, has returned. Unfortunately, the older case has been lost track of, so that his ultimate condition can not be reported.

In one of these cases, we have demonstrated by ventriculography not only that the new foramen of Magendie is patent and functioning but that the hydrocephalus has been cured (Fig. 8). Six weeks after leaving the hospital, the patient returned for observation and air was injected into a lateral ventricle in order to test the new foramen. The roentgenogram (Fig. 8) shows the tremendous enlargement of the lateral ventricles; the third ventricle, the aqueduct of Sylvius and the fourth ventricle are sharply outlined. The air has passed through the new foramen of Magendie—which is marked by the silver clips which were placed over a divided blood vessel at operation—into the cisterna magna. The air is even seen to fill the cerebral sulci, showing that the most remote branches of the subarachnoid space receive fluid from the ventricles and that, therefore, the hydrocephalus has been cured.

CONCLUSIONS

1. Blocking of the foramina of Luschka and Magendie invariably produces hydrocephalus. Patency of one of the three foramina prevents the development of hydrocephalus, provided the subarachnoid space is normal.

2. A group of cases is presented with occlusion of these foramina and with a hydrocephalus resulting therefrom.

3. Undoubtedly, the disease, occuring in adult life, follows an inflammatory process

which may or may not have been clinically evident. Probably, failure of the foramina to develop accounts for the hydrocephalus in many cases which are recognized soon after birth; in other infants an intra-uterine or postnatal inflammation is the cause.

4. Although the general results of the occlusion are the same in every case, there are marked local anatomical differences due to the extent of the inflammatory process and the time of its development.

5. There are no clinical features which permit one to make an absolute diagnosis of occlusion of the foramina of Magendie and Luschka. In every intance, both in adults and infants, the diagnosis of hydrocephalus is possible; the exact site and the character of the obstruction causing the hydrocephalus can be determined by ventriculography and by the phenolsulphonephthalein test.

6. The lesion can always be found at operation.

7. An operative treatment is presented. Two adult cases have apparently been cured by this procedure, which attacks the cause directly.

THE SURGICAL SIGNIFICANCE OF THE COMMON BILE-DUCT SPHINCTER

By GOLDER L. McWHORTER, M.D., Ph.D. in Surgery, Chicago

IT is not generally understood that bile-ducts are of other than anatomical importance. The relation of the bile and pancreatic ducts is variable but they usually join near their termination and are normally surrounded by a sphincter muscle. I will consider, first, the relation of the bile and pancreatic ducts to each other and their relation to the sphincter muscle as possible factors in acute pancreatitis; second, the relation of the surgery of the bile-ducts to the sphincter muscle.

In the embryo, at the level of the hepatic diverticulum, the pancreas develops from the duodenum in two buds or anlages; one ventral, one dorsal, the former being associated with the hepatic diverticulum. The ventral bud may contain two lateral halves. The lower part of the head of the pancreas develops from this bud while the remainder of the head, body, and tail develop from the dorsal anlage. The duct from the part of the pancreas which develops from the ventral anlage becomes the chief pancreatic duct, by receiving, later, most of the secretion from the body and the tail. This is the duct of Wirsung. Occasionally the accessory duct which drains the upper part of the head is absent and the entire drainage is through the duct of Wirsung. Opie found the duct of Santorini the larger duct in one out of every ten cases.

The relation of the bile and pancreatic ducts is more variable than one realizes from a textbook description. The two usually join in the duodenal wall and open into an ampulla which opens into the duodenum. Baldwin, in an examination of 90 specimens, found that in 25.8 per cent of them the ducts opened separately into the duodenum while in 74.2 per cent, the ducts had a common ampulla. In 100 specimens, Opie found no ampulla in 11 per cent. The ampulla varied from 1 to 11 millimeters in depth and in only 32 per cent did it equal or exceed 5 millimeters. The orifice had an average diameter of 2.5 millimeters. In about one-third of the specimens the diameter of the orifice was equal to, or greater than, the length of the diverticulum. Opie found anatomically that in only 3 out of 10 individuals could a calculus lodge at the outlet of the ampulla and divert bile into the pancreatic duct. Letulle found that only 6 out of 21 specimens had a true ampulla.

It is preferable to divide the terminations of the bile and pancreatic ducts into three chief groups:

1. Ampulla type, in which the two ducts open into an ampulla (Fig. 1).

2. Separate opening of the ducts (Fig. 2). This type may be subdivided into (a) separation of ducts by only a thin septum; (b) independent opening of the duct or a possible absence of the duct of Wirsung.

3. Opening of the pancreatic duct into the bile-duct or a possible opening of the bile-duct into the pancreatic duct above the sphincter (Fig. 3).

In the ampulla type and in that of the junction above the sphincter, obstruction at the outlet might produce a direct channel for bile to pass up the pancreatic duct. In group two, where the ducts open separately, it would be necessary for the bile to enter the duodenum first.

The presence of a sphincter muscle at the lower end of the common duct was suspected by Glisson, 1597–1677, who observed that the orifice would close after the removal of a probe. It was not until 1887 that Oddi demonstrated the existence of a true sphincter muscle independent of the muscle of the duodenal wall. He found this composed of a thin layer of unstriped muscle fibers encircling both the bile and pancreatic ducts.

Helly demonstrated many longitudinal and oblique fibers in addition to the circular ones. These muscle fibers gradually disappeared in the mucosa of the papilla. Helly found that these fibers usually tended to form a figure of 8 with the large ring around the bile-duct, the smaller, around the pancreatic duct. Hendrickson in some cases found no muscle between the ducts but found that the sphincter surrounded both. These muscle fibers were found, by Helly, to fuse somewhat with the intestinal muscle and with the muscularis mucosa superficialis. Hendrickson found that in man the common duct goes directly through at right angles to the inner muscular wall. It does not pass at right angles through the outer wall, however, but passes obliquely downward. He found many of the sphincter fibers to be U-shaped, some longitudinal and some diagonal, fusing or decussating around the common and pancreatic ducts.

In the ampulla are many valve-like folds which may be compared to a rosebud. These folds are of value in preventing regurgitation of duodenal contents.

PHYSIOLOGY OF THE SPHINCTER

Rost suggested that probably at each contraction of the gall-bladder the papilla opens.

Oddi believed that the function of the sphincter is probably to render intermittent, and to regulate the discharge of bile into the intestine. Helly concluded that through the contraction of the sphincter there was diversion of the bile into the gall-bladder.

Meltzer believes that during the storage of bile in the gall-bladder the sphincter muscle is contracted and the bladder muscle is relaxed; during discharge the gall-bladder muscle contracts and the sphincter relaxes. He states that the stimulation of the central end of the vagus causes a contraction of the gall-bladder and inhibition of the sphincter.

Bainbridge and Dale found that stimulation of the right splanchnic nerve or the injection of adrenalin is normally followed by relaxation of the gall-bladder. They regard motor effects, such as obtained by Doyen, as artefacts, although there may be some contraction with a low blood pressure.

THE SPHINCTER CAUSE OF ACUTE PANCREATITIS

While pancreatitis of bacterial origin may occur by the hæmatogenous route and also by the lymphatic route from a neighboring infection, as stated by Deaver and others, acute pancreatitis is usually at first sterile. The production of experimental pancreatitis proved that many substances might produce acute pancreatitis either with or without fat necrosis. Some of these are:

1. Injection of bile and bile salts;

2. Acid gastric juice (Hlava), bacillus coli, bacillus diphtheria, bacillus capsulatus of Friedlaender, bacillus pyocyaneus, or their acid products;

3. Duodenal contents which may regurgitate through a dilated pancreatic duct or sphincter (Hess)—enterokinase failed to produce it (Polya, Williams, and Busch);

4. Trauma, when combined with occlusion of the blood-vessels;

5. Injection of oil, alkalies, nitric acid, and chromic acid;

6. Diphtheria toxin and papain ferment.

Under certain anatomical and mechanical conditions bile may enter the pancreatic duct

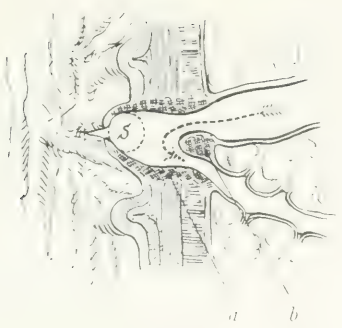

Fig. 1.

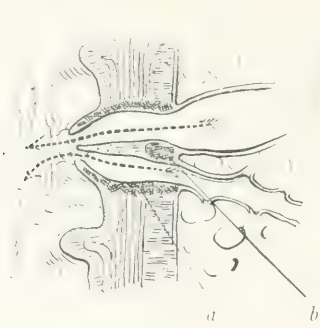

Fig. 2.

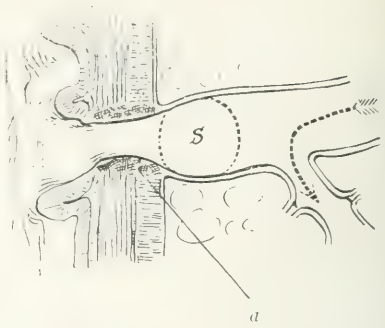

Fig. 3.

Fig. 1. Relation of the bile and pancreatic ducts in the ampulla type. Obstruction at the outlet of the ampulla, such as by a small stone, *s*, might divert the bile into the pancreatic duct as indicated by the arrow. *a*, Sphincter muscle surrounding lower end of bile and pancreatic ducts. *b*, Portion of sphincter between the ducts.

Fig. 2. The ducts empty separately into the duodenum. Obstruction at the outlet could not divert the bile into the pancreatic duct.

Fig. 3. The pancreatic duct opens into the bile-duct above the sphincter, *a*. There is no true ampulla. A calculus, *s*, could divert the bile into the pancreatic duct. The arrow indicates the bile flowing into the pancreatic duct.

directly without a regurgitation from the duodenum. This may be done by obstruction below the junction of the two ducts. Opie believes that in obstruction of the outlet of the ampulla of the common duct by a small calculus, bile may be forced directly into the pancreatic duct (Fig. 1). If the calculus is large, the bile cannot go by it and pressure may also obstruct the pancreatic duct.

Cholelithiasis was found in 105 cases collected by Egdahl to be present in 44 of the cases of acute hæmorrhagic pancreatitis which usually occurs between the ages of 20 and 60 years. The average frequency of gall-stones in all necropsies collected by Mosher was 8.9 per cent between the ages of 21 and 60 years.

Archibald believes the sphincter at the outlet is a factor. He was able to produce acute pancreatitis by injecting bile into the bile-duct at an increased pressure, the only resistance to the outflow of bile being the sphincter. He believes increased irritation of bile, increased pressure of the bile, or obstruction at the outlet are conditions favoring pancreatitis.

Bile becomes more irritating after an increased proportion of bile-salts, reduction of mucin, and infection. Obstruction of the cystic duct would decrease the mucin content. Abnormal rise of pressure in the biliary system occurs either from contraction of the gall-bladder or increased liver secretion. Bile secretion is influenced by the blood pressure and stimulated, to a small degree, by secretin (Bayliss and Starling).

Obstruction at the outlet may be due to: first, foreign bodies, as a small calculus, mucous plug, a seed or parasite; second, narrowing of the lumen itself by contraction of the sphincter, swelling of the wall, stricture or pressure. Spasm of the sphincter may be brought about by hyperacidity. Experimentally hydrochloric acid applied to the duodenal mucosa will produce a spasm of the sphincter. Nordmann experimentally tied off the outlet of the papilla and produced acute pancreatitis by forcing bile or infectious material into the common duct. Without injecting, there occurred only dilatation of the ducts, jaundice, and only rarely fat necrosis (Archibald).

Fat necrosis when present is such a pathognomic sign of acute pancreatitis that I want to emphasize it by showing a microscopic section taken from a recent case having extensive fat necrosis throughout the abdomen (Fig. 4). There were no gall-stones palpable in this case, a woman, age 59. The bile was very thick and black and cultures were sterile. The cause of the fat necrosis is almost certainly the pancreatic lipase, steapsin. Dettmer was unable to produce fat necrosis from trypsin. Dissemination takes place probably by way

of the lymphatics. The fat necrosis is produced by the lipase splitting the fat into glycerin and fatty acids. The glycerin diffuses, leaving behind solid fatty acids. Necrosis of the cells takes place and eventually the fatty acids combine with calcium salts and are precipitated. These appear grossly as rather yellowish or gray particles, often as large as a small pea. Microscopically a zone of round cells or connective tissue may encapsule or absorb the fat necrosis.

The resistance of the sphincter of the bile-duct in animals was found by Archibald to equal 500 to 650 millimeters of water. Mann found in normal dogs and cats that the resistance was somewhat variable but rarely over 100 to 150 millimeters of water. Archibald was able by operations upon the sphincter to reduce the resistance from 500 to 650 millimeters to about 70 millimeters, which persisted at least 8 weeks.

Judd and Mann found that after cholecystectomy the bile-ducts dilated and that the bile pressure gradually dilated the sphincter. The residual pressure fell, in some cases, later to zero after cholecystectomy and was rarely greater than 40 millimeters of water. After cutting the mucosal outlet the bile-ducts in one experiment were filled with ascaris. They concluded that the dilatation of the common duct by bile pressure after cholecystectomy does not prevent the guarding of the duodenal opening by the fold of mucous membrane.

After cholecystectomy and duodenostomy Rost found two varying results. One group maintained a continent sphincter, and the bile-ducts had dilated and their action was functionally similar to those with a gall-bladder. In the second group the sphincter was incontinent, and the bile-ducts were found with little or no dilatation.

In a study of the sphincter action and surgical procedures to facilitate bile drainage, I have performed several series of different experiments. I have used dogs throughout and have tested the sphincter or performed operations upon the biliary tract in 45 animals.

Improved bile drainage clinically may be accomplished in some cases by draining the bile from a tube in the gall-bladder or common duct. This might be of value in case the bile were infected and irritating to the duct and possibly in cases of pancreatitis. In some cases of gall-stones with a pancreatitis a cholecystenterostomy has been advised by Bevan.

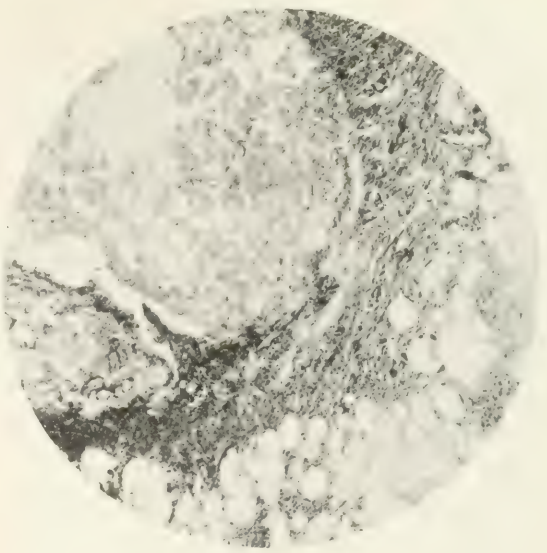

Fig. 4. Photomicrograph. Area of fat necrosis in the omentum from a patient with acute pancreatitis. This is surrounded by a zone of round cell infiltration with normal tissue outside.

Reducing the resistance of the sphincter in several ways will facilitate bile drainage. Experimentally Archibald and Mann have cut the sphincter. Objection to this is that of obstruction due to the ascending of intestinal parasites into the bile-ducts and also the danger of infection. The removal of the gall-bladder may be followed by partial or even complete loss of the sphincter resistance (Judd and Mann).

Rost has shown that the secretion of bile and pancreatic juice is decreased in cholecystectomized animals after a test meal and after injecting large amounts of chyme into the duodenum. This may be due to a variation of secretin due perhaps to altered gastric secretion.

Provided that the sphincter does divert the bile into the pancreas, it would seem to me that it would continue to do so after cholecystectomy until the sphincter would be dilated.

If that is true, then the force of the bile which dilates the sphincter would necessarily be greater than normal or no dilatation would result. Consequently cholecystectomy might aggravate a pancreatitis before the sphincter resistance is lowered.

The liver secreting pressure normally is between 250 and 350 millimeters of water (Mitchell and Stifel). That cases of exacerbation of a pancreatitis have not been reported would lead one to question the method of paralysis of the sphincter, or that the sphincter tonicity acts in that way as a cause of the pancreatitis.

Cholecystectomy may have some benefit now not understood. This may act by an indirect reduction of bile, or in the changing of nerve reflexes. Rost has shown that decreased bile and pancreatic secretion follow cholecystectomy.

The action of drugs upon the sphincter and gall-bladder is of interest. Meltzer has shown that a 25 per cent magnesium sulphate will aid in the relaxation of the sphincter when applied directly to the duodenum. Lyon claims it to be of therapeutic value in aiding the passage of stones. Rost after injecting a 3 per cent peptone solution into a duodenal fistula found a contraction of the gall-bladder and a relaxed sphincter with immediate discharge of bile. Other substances, as impure olive oil, may act in a similar way. Bainbridge and Dale found that bile salts, atropin, and amyl nitrate relaxed the gall-bladder and also nicotine which acted like adrenalin. Pilocarpine and peptone produced an apparent contraction but they found this due to swelling of the liver.

Under ether anæsthesia I found 25 per cent magnesium sulphate applied to the duodenum to reduce the resistance of the sphincter about 50 to 100 millimeters of water. It produced a transient action but never completely relaxed the sphincter. In one experiment with a resistance of 280 millimeters of water it reduced the water column to 180 to 230 millimeters. In another with a resistance of 200 millimeters, the application of 25 per cent magnesium sulphate reduced it to about 100 to 150 millimeters of water. There was no definite effect after application of a 3 per cent peptone solution. Adrenalin increased the tension of the sphincter slightly. The resistance of the sphincter I found in about 25 animals to be between 100 and 200 millimeters of water, as a rule, but frequently as low as 50 or as high as 250. Occasionally it was higher, in one case 580 millimeters of water.

Operations upon the sphincter to reduce its action were done through a duodenotomy. Cutting the mucosa had no effect and it was only after extensive incisions into the duodenal wall that I was able to cut the sphincter and overcome its resistance. I found that unless deep cuts were made into the wall that there was no paralysis. The danger of this deep cutting is the cutting through the entire wall and the production of a fistula into the peritoneal cavity. Consequently, I did not find this method feasible.

Dilatation of the sphincter was done in a series of animals. I first attempted air dilatation by means of a rubber balloon. Pressure equal to 250 millimeters of mercury was used. This produced but a temporary decrease in sphincter action. Dilatation by means of a small hæmostat was then done. By quite severe dilatation the sphincter action was paralyzed; moderate dilatation had only a slight and temporary effect. I dilated the sphincter in a series of six animals which were retested after varying periods of time. There was a reduction in its resistance in three experiments from 180 to 200 millimeters to about 25 to 50 millimeters of water by dilatation. After the periods of time of 14, 26, and 53 days the animals were retested. In these animals there was some sphincter action but it had evidently been permanently lowered and was practically the same as after the dilatation. In the other three experiments the sphincter action was decreased to only about one-half normal from 325 millimeters of water to 125 millimeters. The period of retesting was 21, 45, and 47 days. In these experiments the resistance was definitely lowered at the second operation. In all three it was approximately 125 millimeters of water at this time. This illustrates that dilatation severe enough to reduce the sphincter action will have a permanent effect.

By means of a small rubber tube, usually about a No. 12 F. catheter or a cannula, passed through the sphincter, the water immediately dropped to water level. If this could be done safely clinically, drainage of bile would be facilitated and it would also reach the intestine. I put a short tube through the sphincter in a number of experiments, in some through a duodenotomy, in others through an opening in the duct. I placed in addition an abdominal drain down to the opening in the common duct in some of these experiments. In a third series I used a T tube in the duct placing one end through the sphincter into the duodenum. The objection to the tube in animals is that on account of the small lumen it becomes obstructed easily. Where a choledochotomy has been done this obstruction forces the bile to break through the suture line. The bile may escape around the tube dilating the sphincter and wall. In three animals I inserted a tube through the sphincter and later retested the resistance. In two of these I put the tube in through an opening in the common duct and then put a drainage tube down to it. I found that the resistance of the sphincter before operation was about 130 to 150 millimeters of water. On retesting at the end of 15 and 45 days the tube had gone out but the resistance was about 80 to 100 millimeters of water. In the third experiment I put the tube in through and sutured it to the duodenum. On retesting at the end of a week, I found the tube gone and practically no change in the resistance of the sphincter.

In three experiments where the tube remained in the bile-duct sutured to the duodenum, I found on retesting at the end of 3, 8, and 15 days that the tube had become occluded and bile was passing around it. On removing the tube there was no resistance of the sphincter. It is evident that a tube will act in dilating the sphincter if the lumen is occluded and bile forced around it, otherwise only a slight dilatation is evident. In other words, the paralysis of the sphincter is proportionate to the degree of dilatation. In six experiments I put large shot into the lower end of the common duct. Where an incision was made into the duct for this purpose, invariably the bile pressure broke it open. This occurred in some cases where a tube obstructed the outlet. It is evident that bile obstruction from any cause will tend to produce a leakage of bile at a point of lowered resistance.

The dangers of opening or reducing the resistance of the sphincter must be considered in connection with the possible advantages. There is danger in the entrance of intestinal parasites into the bile tracts. I had one animal die as a result of an ascaris crawling up and getting caught in the rubber tube extending into the duodenum. This produced biliary obstruction and a breaking down of the sutured common duct.

The passage of infection up the bile passages to the liver and gall-bladder must be considered.

In a series of ten animals I took cultures from the gall-bladder and duodenum. The cultures were sterile from the gall-bladder in all cases. Cultures from the duodenum were sterile in 2 cases.

In three experiments I put a tube into the sphincter and bile-duct through a duodenotomy and sutured it to the wall. At the end of 3, 8, and 15 days I killed the animals and took cultures from the gall-bladder, liver, and duodenum. The gall-bladder cultures were sterile in all cases. Cultures from the liver were sterile in only one case at the end of 8 days. Growths were obtained in all duodena. The organisms found were fairly constant and similar in the liver and duodenum in most cases. There were frequently two organisms found, the most constant being a gram positive diplococcus. While only in a small series of experiments, this illustrates the possibility of ascending infection into the liver and gall-bladder, by means of a tube through the sphincter into the duodenum.

CONCLUSIONS

1. Stasis of the bile should be avoided by proper diet, exercise, and dress.

2. Physiological drainage of bile by means of a straight or T tube through the sphincter may be of value in certain diseases of the bile tracts where bile is needed in the system or as a means of instituting duodenal infusion.

3. Diminution of sphincter action may be obtained surgically by cutting, dilating, or putting a tube through it.

4. The mechanics of bile drainage is important and recovery is dependent upon its proper application.

5. Primary suture of the common duct is liable to break down in the presence of obstruction lower down or in case of a disturbance of the local blood supply. An abdominal drain should be put in for a safety valve.

6. The sphincter normally guards the bile-ducts from ascending parasites, foreign bodies and infection. Under certain diseased or anatomical conditions of the bile passages and possibly also of the pancreas a diminution of its action may be desirable.

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PUDENDAL HERNIA

Operation by Abdominal Route, No Recurrence in Two Years[1]

By JAMES FRANCIS GRATTAN, M.D., New York

UNUSUAL types of hernia are always interesting, both from a diagnostic standpoint and because by their very nature they offer original problems to the surgeon. The symptomatology is usually indefinite and misleading. The patient comes armed with a variety of diagnoses accumulated after a year or two of "shopping for relief." When the hernia idea is suddenly added to the list of possible causes for the symptoms, surprise is usually mixed with doubt, and considerable demonstration is necessary to disprove the supposed causes.

I must confess that the surprise occasioned by the diagnosis of hernia in this case was no greater to the patient than to myself. On account of the rarity of the pathology, it is scarcely necessary to add that the finding was accidental.

History. Mrs. M. F., age 53, came to me in July, 1918, for relief of a condition which she described as "irritation in the rectum with difficulty in moving the bowels, and in addition, a bearing down sensation in the vagina" ascribed by two physicians who had examined her within the year to "falling of the womb." The rectal trouble was further described as "a desire to empty the bowels, often quite urgent, but without result except with the aid of an enema." The inception of this trouble dated back 4 or 5 years, but remained quite tolerable to within a few months preceding her first visit, when the "attacks" increased in frequency and severity, causing considerable worry and discomfort. She had never noted any blood in the stools. She added that her brother had died recently following an operation for cancer of the rectum. Naturally, I ascribed her concern to the recent family loss but decided to use the proctoscope as part of the physical examination.

The marital history showed three pregnancies, including a difficult twin delivery with loss of one of the twins as a result of the protracted labor. The patient had always done hard physical work about the house through necessity. The condition mentioned as "falling of the womb" was regarded by the patient as the usual legacy of a hard-working mother of several children, but the rectal trouble caused her real concern.

Physical examination. General survey: An obese type woman of middle age, height about 5 feet 4 inches. Color slightly cyanotic. Facies slightly suggestive of a nephritic condition. Slight dyspnœa on exertion. Thyroid, heart, lungs, and extremities showed nothing of interest. Abdomen pendulous. No umbilical, inguinal or femoral herniæ. Urine showed a faint trace of albumin.

Local examination. Vaginal examination showed nothing unusual except it be the well retained vaginal walls (without a suggestion of cystocele or rectocele) and a small well located uterus, all of which argued against the prejudice created by the history in favor of a prolapse of the uterus. The cervix was small and normal, the vulva normal. Digital examination of the rectum was negative. There was no prolapse. No hæmorrhoids. Proctoscopy revealed nothing to account for the symptoms.

I decided to reassure myself by repeating the vaginal examination. With the examining fingers of the right hand in the vagina, I told the patient to hold her breath and strain downward. Nothing happened. I asked her to cough several times. All these procedures failed to cause any perceptible descent of the uterus, but as she repeated the cough I thought I felt an impulse against the back of my examining hand. I had her repeat the cough ten or twelve times, and as she did so I observed and felt a definite impulse in the adductor region of the left thigh. A mass the size of a hen's egg developed at the site of the impulse. The mass was soft, reducible, and gurgling occurred on manipulation. The location was a crescentic area external to the left labium majus, but not involving that part. The gurgling, the definite impulse on coughing, and the reducibility upward of the mass satisfied me that I had found a hernia containing intestine, in an unusual location. The patient complained that my manipulations reproduced to some degree the symptoms referable to the rectum, and also gave that sense of "bearing down," formerly ascribed to "falling of the womb." To repeat, I knew that she had a hernia, but to explain its course of descent was a real problem. In a general way I argued that it must have emerged through some rent in the pelvic floor occasioned by muscular separation during the difficult twin labor. I hoped that exploration would throw further light on the true anatomy of the condition.

Operation. Seeing no advantage to approaching from below and fearing that I would lose my landmarks in following the sac from below upward, I chose the abdominal route. A suprapubic incision extending from the symphysis to the umbilicus was necessary on account of the extremely fat abdominal wall. The exposure of the pelvis was difficult be-

[1] Read (by invitation) before Section on Gynecology and Obstetrics, New York Academy of Medicine, October 26, 1920.

cause of the great amount of intra-abdominal fat and the risk of the exaggerated Trendelenburg position in an adipose subject. Exposure of the pelvic organs finally revealed descent of the sigmoid loop through a triangular opening in the floor of the pelvis. This opening was bounded anteriorly by the posterior reflection of the left broad ligament, mesially by the lower segment of the uterus and the left uterosacral ligament, laterally and posteriorly by the rectum. The sigmoid being fixed at its point of continuation into the rectum, appeared to slide down along the posterior surface of the broad ligament and disappear through the hernial opening. Practically the entire loop was out of view. Much to my surprise gentle traction brought the entire sigmoid loop out of the sac. There were no surface adhesions and no evidences of constriction at any point. The opening was triangular in outline with the uterosacral ligament forming the base, the reflection of the broad ligament the anterior arm, and the rectum (in an irregular sense) the posterior arm of the triangle. I inserted my left index and middle fingers downward into the sac and had the nurse uncover the inner side of the left thigh and identify the fingers through the skin covering the sac. There was no process of the sac descending into the left labium as in the cases of "pudendal" hernia reviewed by Moschcowitz.[1] However, the exit and course of the descent in this case was undoubtedly the same; the final destination being the subcutaneous tissue of the upper adductor region of the thigh rather than the labium.

Gross surgical anatomy. The protrusion undoubtedly occurred through a rent in the levator ani muscle and passed through the triangle bounded externally by the ischiocavernosus, internally by the constrictor cunei and posteriorly by the transversus perinei, and along the left lateral wall of the vagina, emerging in the thigh. The split in the levator was probably the result of the difficult twin labor mentioned in the history. The "bearing down" feeling was a natural accompaniment of the hernia. The rectal symptoms were undoubtedly due to the partial kink produced at the rectosigmoid junction when the sigmoid loop descended into the sac. The ready extraction of the sigmoid from the sac at operation explains the spontaneous reducibility and freedom from symptoms in the intervals.

Closure of the ring. Needless to say, no attempt was made at extirpation of the sac. Its depth, the adipose status of the patient, her age, as an argument against prolonging the anæsthetic needlessly, precluded this. With great effort and difficulty I passed 5 or 6 mattress sutures of double Pagenstecher linen across the long arms of the triangle and succeeded in closing it tightly and completely. To make doubly sure I whipped a continuous suture over the line of mattress sutures, taking another reef in the broad ligament. This last step caused a version of the uterus backward and to the left superimposing the fundus over the site of the hernial opening. The sigmoid was anchored to the left psoas muscle at the brim of the pelvis and again about 2 inches above that point, the idea being to prevent its descending to its habitual location in the vicinity of the hernial opening.

The abdomen was closed by layer sutures. The patient made an uneventful recovery. I kept her in bed 3 weeks. Mineral oil was used for 6 months following the operation to assure a daily evacuation. This is not necessary at present. The sense of prolapse and the rectal irritation have never been experienced since the patient left the hospital.

As stated above, at the time of operation I was at a loss to classify this hernia anatomically. I have published it as a pudendal hernia because I feel sure that its exit corresponds to the cases of pudendal hernia described by Cooper in his volumes on hernia published in 1807 and to the cases collected under the heading of pudendal hernia by von Winckel in 1881, and reviewed by Moschcowitz in his paper referred to above. Eleven authentic cases are listed by Moschcowitz. He doubts the probability of occurrence of such hernia in the male. According to him no case of cure of this type of hernia is recorded.

Difficult labor, with the consequent strain, resulting in separation of the levator ani fibers followed by descent of the protruding viscus through the normally weak triangle bounded by the ischiocavernosus, constrictor cunei and transversus perinei, seems to be the logical explanation of the occurrence of so-called "pudendal" hernia. The quotation marks represent the fallacy of naming this hernia for its destination (the vulva) rather than for its point of exit in the pelvic floor. My case demonstrates this fallacy because the destination of the sac happened to be the adductor region of the thigh rather than the pudendum. J. A. Blake suggested the term "levator" hernia. However, I did not feel justified in making a new classification for a hernia the course and surgical anatomy of which was essentially the same as in the cases described under the term pudendal hernia.

Two years have elapsed since I operated upon this case, and repeated examinations fail to show recurrence. The patient has through necessity performed all the heavy work of the household during these 2 years and I feel hopeful that the danger of recurrence is past.

[1] Moschcowitz, A. V. Am. J. M. Sc., 1918, clvi, 394.

VARICOSE VEINS OF THE FEMALE PELVIS

A Preliminary Report[1]

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PERHAPS no other subject in the large field of gynecology has been treated as negligently as the one on varicose veins of the female pelvis. There are only a few important clinical reports in the literature, the earliest by Winkel in 1886, the last by Miller and Kanavel in 1905, and the most important by Dudley in 1889. The occurrence of these varicosities had been reported upon prior to Winkel, but the data were only of pathological and not of clinical value. Among the textbooks only the one by Skene published in 1895 does justice to the subject. Many of the others barely touch upon it, and some of the best do not mention it at all. But wherever it is mentioned, emphasis is laid upon the frequency of these varicosities. Nevertheless, only a few general remarks are made as to symptomatology and diagnosis, and the reader is left with the idea that these venous distentions are more or less an operative incidence. Notwithstanding this, we are told by those who have reported on the subject, that a diagnosis can be made and treatments have been suggested. In order to substantiate or disprove this, I have chosen to collect the data from the histories of patients in whose operative diagnosis varicose veins of the broad ligaments were recorded. Between September, 1913, and September, 1919, 28 such patients were operated upon in the service of the Women's Clinic of Stanford Medical School. To this number I can add 7 patients operated upon in private practice for the same condition. The findings in 35 patients verified by operation and in the majority observed over a sufficiently long postoperative period should allow us to come to conclusions which will either disprove or prove that varicose veins of the female pelvis give definite symptoms and can be diagnosed.

There are five plexus of veins in the pelvis with which we are concerned: the vaginal, vesical, uterine, and hæmorrhoidal plexus which drain into the inferior hypogastric vein, and the parovarian or pampiniform plexus which empties through the ovarian veins into the vena cava on the right side and into the renal vein on the left side. In the entire venous structure there is only one valve and that lies at the end of the right ovarian vein.

Comparing the support of the various venous units, it is at once apparent that the vessels in the base of the broad ligament, that is the uterine veins, fare the best. The tortuous arteries which enter the parametrium from above passing downward and then gradually ascending until near the uterus they rise at almost right angles are supported very securely by a mass of dense connective tissue mixed with smooth muscle fibers. The very much straighter veins hug the artery closely on their way out and derive the full support of the perivascular tissue. Each vessel or its ramifications is therefore strongly fortified and guarded against sudden overdistending. An entirely different picture confronts us in the ovarian circulation. There are two plexus of veins here, one above and one below the hilus of the ovary, which make up the pampiniform plexus. The branches are very tortuous and numerous and lie in a support poor in connective tissue and practically devoid of muscle fibers. Where the pampiniform plexus empties into the ovarian vein, the supporting tissue is still more poorly developed and for the distance of 7 to 9 centimeters the ovarian vein swings, so to speak, in a hammock formed by two thin layers of peritoneum only, with very little padding to rest upon. This hammock is securely suspended at the pelvic brim at a point where the ovarian vessels cross the iliac vessels. At the other end it is hitched to a movable organ, the uterus. It therefore has only one definitely fixed point around which it must swing when the other end varies in position. If the human body stands

[1] Read before the Section on Gynecology and Obstetrics at the Meeting of the Medical Society of the State of California May, 1920, Santa Barbara

TABLE I

Location and change in the intensity of pains noticed:

In both lower quadrants	12
In left quadrant only	11
In right quadrant only	6
Not specified	6
Worse when up	13
Relieved on lying down	22
Not specified	13
Worse at catamenia	14
Constipated	15

Menstrual disturbances:

Dysmenorrhœa	14
Irregular intervals	11
Menorrhagia	7
Scanty flow	5
None	8

Probable causes as analyzed from the history of the patient:

Abortion	8
Childbirth	16
Masturbation unmarried	2
Sexual excess married	1
Visceral ptosis (?)	3
No reason	5
Total	35

TABLE II

Pre-operative diagnosis		Normal white count	Leucocytosis
Double salpingo-oophoritis	4	3	1
Pelvic inflammatory diseases	7	6	1
Malposition of uterus	10	9	1
Malposition and varicose veins	5	2	3
Varicose veins	6	5	1
"Pelvic tumor"	1	1	.
Fibroids	2	..	2
Total	35	26	9

Varicose veins found at operation and associated pathology noted:

Retroversion	20
Retroposition	4
Descensus	2
Relaxed perineum	6
Intestinal ptosis	4
Cervicitis	5
Piles	10
Fibroids	2
None	9

Operation and after-results:

Type	No.	Relieved 3 months	Relieved 6 months and more	Symptoms returned	Patients not seen again
Webster	6	..	3	1	2
Kelly-Neel	10	..	6	2	2
Gilliam	9	3	6	..	..
Coffey	1		1	..	..
Utero-sacral	2	2	..	..	..
Resection of veins	3	..	2	1	..
Hysterectomy	4	..	4	..	..
Total	35	5	22	4	4

erect, the ovarian vessels form an inverted parabola in their lower third or pelvic division and then ascend vertically for the other two-thirds. The right vein is somewhat guarded against backflow from other sources by the intersecting valve at the vena cava. But the left, which enters another venous stream, the renal vein, at right angles, is without a protective valve and therefore open to venous backflow.

Considering the strong support of the veins in the base of the parametrium and the poor safeguard of the ovarian circulation, it is clear that if there arises an interference in the venous flow of the uterine circulation, dilatation of their venous units will be held in check for a long time by the perivascular tissue, but if the same would occur in the ovarian circulation the venous units soon will have to give since there is no support. This distention takes place first at the lowest end of the inverted parabola of the ovarian vein because here two antagonistic physical forces meet and that is the weight of the column of blood rising vertically and the driving force of the increased column of blood coming from the other direction. The weight of the column must by necessity overcome the driving force because the latter is weakened by the compensatory distention of the venous channels. With progressive distention the units of the pampiniform plexus are gradually affected until ultimately the uterine and other plexus of the pelvis are involved also by virtue of their intimate relation through the anastomotic uterine vein.

I have nothing to say on congenital varicose veins of this type. They have not been described in the newborn. Where they were found in the virgin in our series they could be traced to other causes. We may assume, therefore, that varicose veins of the pelvis are always acquired. But we must not confound "acquired primary" with "secondary." By the latter we mean that another distinct pathological disarrangement was present before the veins were formed. Both conditions are possible and should be carefully separated; for instance, "acquired secondary" varicose veins may follow uterine displacements.

Any change in the position of the uterus, either backward or downward, must interfere with the venous drainage in the base of the broad ligament or in the ovarian units. Thus, a retroflexion of the uterus may kink the ovarian vessels at the pelvic brim. Here dilatation of the ovarian veins results first and the uterine veins suffer later. On the other hand any descent of the uterus must tend to compress or kink the uterine vessels. The uterine tortuous arteries are sufficiently long and strong-walled to overcome this resistance, but the veins must suffer early because they run a straight course and therefore may become compressed or kinked. In other words, the amount of blood going in as compared to the amount of blood going out is out of proportion and another outlet is sought, and found in the anastomotic uterine vein.

"Acquired primary" varicose veins will follow prolonged pelvic congestion in many instances. Pregnancy, intestinal ptosis, habitual constipation, interference with the menstrual flow, prolonged menses, prolonged and often repeated sexual excitement especially if not satisfied by the normal act, high blood pressure, and a number of others will produce such prolonged congestion. The inflammatory congestions are not considered in our group of cases. Pregnancy seems to be the most important factor in this group. Normally, the veins distend tremendously during pregnancy. I cannot say whether it is the loss of tone on account of the long continued distention of the veins that prevents these veins from returning to normal or whether it is a change in the position of the uterus following the birth-function that puts the uterine venous return into a disadvantageous position by kinking it. At times it will be hard to determine cause and effect in the production of these varicosities because one has to deal with a vicious circle. For, it is said, that prolonged pelvic congestion causes softening of the uterine supports which may lead to displacements. They, in turn, aggravate the pelvic congestion by obstruction, thus completing the circle.

Accompanying varicose veins of the ovarian and broad ligaments there is a definite pathology. It seems that the ovaries are affected first. They become cystic with a gradual increase of fibrous tissue due to passive congestion. Later they undergo changes similar to those found at the early menopause. The endometrium is often hyperplastic and œdematous. There is a general tendency toward hypertrophy of the mucous membranes of the mucosa of the entire genital tract. The color is no longer pink but has a purple hue. Later the cervix undergoes hypertrophy and perhaps still later the fundus is involved, ultimately producing a condition which has been variously called "fibrosis" and "chronic metritis" but which is nothing else but the outcome of chronic passive congestion ultimately leading to an overgrowth of the connective-tissue elements.

The relation to sterility is interesting in so far as the presence of a hyperplastic endometrium seems to prevent conception. There are 2 patients in this series who did not conceive during 3 and 4 years of married life. Both had a mild retroversion and a marked endometrial hyperplasia together with very large varicose veins of the ovarian circulation. Both became pregnant after conservative operative interference.

The symptomatology centers around one point and that is the pain complained of and which must be carefully analyzed.

One usually hears that beginning with a definite time there have appeared either bilateral or unilateral, usually, left-sided pains of a dull, deep, aching character felt low down in the abdomen which grow worse on long standing and are relieved quickly when the patient assumes the recumbent position. This one complaint is just as typical for women as it is for men who suffer from varicocele and to which the condition in the female has been likened. If sufficient attention is paid to this point the history becomes suggestive enough to make the examiner look for these veins. All of the other symptoms are obscure and may hold good for almost any pelvic disturbance. There is commonly a sense of heaviness in the pelvis. The patient often suffers from constipation. Leucorrhœa of a white character may be present meaning merely an overstimulation of the endometrial

function by congestion. Backache is a common complaint, most often it is a dull pain felt in one or both kidney regions. At times it is present over the sacrum. The legs "feel weak" and the bladder is often irritable as long as the person is on her feet, and this in the absence of any pathological findings in the urine. This, too, is suggestive of congestion, for this symptom just like those dependent upon ovarian or uterine congestion disappears as soon as the recumbent position allows the veins to drain freely. Gastric disturbances, especially nausea, lassitude, and ovarian pains of the so-called "ovarian neuralgia" type appear in time. The menstrual cycle at first becomes shorter or the flow more profuse until it resembles menorrhagia due to an overstimulation of the ovaries by congestion. Later with the appearance of atrophic and cystic changes, the menstrual cycle once more is disturbed, only the intervals now become either lengthened or the flow becomes scanty.

To gain a quick survey of the symptoms and sequelæ in our series, I offer Tables I and II which speak for themselves.

What difficulties are encountered in the pre-operative detection of varicose veins of the pelvis is gained from a perusal of the second table. In looking over the histories, it struck me that the typical complaint had been usually quite clearly written down by the examining physician. In spite of the usual normal blood count which has been noted in the second table the diagnosis of pelvic inflammatory disease had been made quite often. The reason for this, I think, is the marked tenderness that is experienced by the patient during the examination together with the peculiar doughy feel to the parametrium. As the patient is usually examined in the recumbent position her veins are well drained and, therefore, they are not palpable. One would never fail to examine a man standing up if he would complain of anything pointing to trouble anywhere around the generative organs. Custom has made the recumbent examination in women a standard. If one will take the trouble to examine the patient by rectovaginal touch in the recumbent position and then have the patient drop her legs and raise her upper body it seems to me that it is often as easy to feel these veins in the female as in the male, for the veins will fill quickly and bring out the dilatation and tortuosity in the shape of an easily compressible and doughy tumor that is much less tender than either an inflamed or an ectopic tube. The tumor will disappear again when the patient resumes the recumbent position. I found in private practice that patients do not object to this procedure while they will object at times if they are examined standing up as Dudley suggested in 1889. For the reason given, ovarian varicosities are undoubtedly overlooked at times during exploratory operation for pelvic disturbances, because the habit of having the patient put into the Trendelenburg position before the incision is made, is quite common. There, naturally, the veins are in the most favorable position to drain well. Might it not explain why at times an exploratory operation may not reveal anything in the pelvis or that an appendix may be taken out for right-sided pain and the pre-operative symptoms promptly recur when the patient gets on her feet?

The diagnosis of distended or varicose veins of the broad ligaments in general and of those of the ovarian circulation in particular in the absence of inflammatory changes or tumors is not so difficult as has been pointed out in earlier reports.

The importance lies in an accurate analysis of the pains complained of and a proper examination. A normal blood count which in our series was present in 77 per cent will greatly aid in the differentiation from other diseases. The pains produced by varicose veins easily simulate other diseases, especially chronic appendicitis or ureterorenal disturbances expecially when X-ray shadows have been seen in the region of the lower ureter, where phleboliths occur quite commonly in the pelvic plexus. But a normal urine and a normal or nearly normal leucocyte count would exclude ureteral stone and rather point to varicose veins. Pus tubes and ectopic tubes do not change in size on change in position of the body. Both are accompanied by other definite clinical and laboratory findings that will facilitate the differential diagnosis.

One of the best methods that will aid in the differential diagnosis of chronic appendicitis outside of the type of examination suggested, is the inflation of the colon. If an irritable chronic appendix is present inflation will bring on the pain complained of while it will not do so if the pain is due to distended veins.

In all previous publications it has been said that conservative treatment offers very little hope for ultimate recovery. This statement should be modified in so far as it applies only to advanced stages in venous distention. If we have to deal with an early descensus of the uterus it may well be possible that a proper pessary will keep the uterus at a normal level until congestion has abated and the tissues that support the uterus, have regained their normal tonus. A pessary will be of no value when actual damage has been done to the vessel. If the distention of the ovarian or uterine venous units is directly traceable to constipation, the first principle naturally must be to regulate the bowel and if visceral ptosis is present a proper abdominal support must be added. During the period of any conservative treatment, it is essential that the patient keep off her feet as much as possible so that the veins of the broad ligament may be in the most favorable position for free flow. All sexual excitement should be prohibited. I cannot see any benefit from the use of hot douches recommended by several writers. Hot douches are used to incite pelvic congestion by active hyperæmia. Logical reasoning would be against trying to produce active hyperæmia if all efforts are directed toward reducing passive congestion. Slow lukewarm douches with 2 to 3 per cent menthol and 5 per cent alum will produce a pleasant, cooling effect. Ichthyol undoubtedly helps in reducing pelvic congestion. Instead of using the obsolete tampon, 10 per cent ichthyol vaginal suppositories serve a better purpose. The patient uses them every night over a period of 2 to 3 months. Miller and Kanavel have advised the use of small doses of pituitrin in conjunction with other conservative measures. There is no report available as to the results.

When the veins have distended to such a degree that one must suppose they cannot return to normal, operative procedures must be considered. All writers suggest the resection of these veins in one way or the other. The older authors go a step farther advising hysterectomy as an absolute cure.

In past years I have observed that varicose veins of quite remarkable size as long as they were confined to the ovarian veins and inferior division of the pampiniform plexus disappeared as soon as a proper suspension was done in cases where retrodisplacements of one kind or the other were present with the varicosities. Especially striking was this when there was no retroversion or retroflexion but where the uterus had descended into a retroposition with the fundus remaining in anteflexion. During the last 3 years it has therefore been aimed to lift up the uterus by suspension in order to promote proper drainage of the veins. This procedure apparently is greatly aided by the shortening of the utero-sacral ligaments which act as shelves for the adnexal organs to rest upon. While these shelves may not be permanent, they seem to remain intact sufficiently long to prevent the ovaries from prolapsing and therefore aid in proper venous drainage. Practically all ovaries that are seen in these patients are cystic. I have seen them of three times normal size. To take them out or to resect them defeats the very idea of the principle of the operative treatment. If the pelvic venous circulation will accommodate itself after proper drainage is established, the ovaries will do the same. This has been well proven by clinical and private patients who after the operation returned to normal menstruation and in whom later careful pelvic palpations revealed ovaries of normal size and consistency. As far as the condition of the veins after operation is concerned, I can report only on my 7 private patients and with the exception of 1 who is very obese and where I am not sure of my touch, I am convinced that the veins no longer distend when the patient is examined in the way suggested previously.

Above all, the greatest importance lies in a symptomatic cure and the last part of Table II will give operation and result in a clear way. The number of symptomatic reliefs is sufficiently large to allow us to believe that suspending operations if carried out properly

and in conjunction with uterosacral shortening will give the desired result in the cure of varicose veins of the broad ligaments and of the ovarian veins in particular. Among the suspensions the various modifications of the Gilliam method seem to promise the best results. The Kelly-Neel method has given us some trouble and we feel that it is primarily not strong enough. The Baldy-Webster suspension may, while it has not done so in our hands, kink the ovarian circulation and aggravate the condition. The Gilliam type of a suspension also tends to lift the uterus higher out of the pelvis than the Baldy-Webster suspension. Personally, I no longer pierce the peritoneum to secure the round ligaments, if possible, but dissect them out subperitoneally which is easily accomplished by blunt dissection with a curved clamp. Then the round ligaments are pulled up in their own canals and for a distance of about one inch they are sutured to the under surface of the rectus fascia near and parallel to the midline and as close to the inguinal ring as possible. That will bring the uterus up and into an exaggerated anteversion instead of hanging slightly backward on its ligaments as in the original method of Gilliam. The dissection of the round ligaments in this way serves two purposes. It prevents the peritoneum from being drawn up or from making a ring through which intestine might herniate and it furnishes a more "naked" round ligament if one may say so, which offers a greater surface to become adherent to the fascia above.

At times if the superior division of the pampiniform plexus is very markedly varicosed it may be necessary to resect some of its veins. In fact that is the only place where resection may become necessary when a rupture of the veins has taken place. Of late we have not found it necessary to resect any of these veins but have trusted in the simple suspension with apparently good results.

Hysterectomy may become necessary if fibroids or advanced polypoid changes of the endometrium demand it, or when the uterus has so greatly atrophied that it cannot be used as a suspending medium any longer. Otherwise, this operation should not be considered under the operative treatments for varicose veins of the broad ligaments.

The last table which gives you the operative procedures and the results of several operators, allows us to believe that simple suspension in which the uterus is well elevated is the ideal remedy for varicose veins of the pelvis.

CONCLUSIONS

In summing up it can be concluded from these observations that varicose veins of the broad ligament in general and of the ovarian circulation in particular are comparatively common occurrences in women;

That, the symptomatology is plain enough in most uncomplicated cases to suggest their presence;

That, the diagnosis is, in most instances, made certain by rectovaginal examination in the recumbent, alternating with the sitting position;

That, the differential diagnosis is aided by the normal leucocyte count;

That, mild and early cases can be permanently relieved by conservative measures;

That, the resection of the veins, or more so hysterectomies, is unnecessary to accomplish a cure;

That, a high suspension of the uterus with a shortening of the uterosacral ligaments offers the best means for a permanent symptomatic cure with a possibility of a permanent anatomical regulation.

FURTHER OBSERVATIONS ON URETEROCELES

Review of the Literature and a Report of Four Cases

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As far back as 1856, Lilienfeld (1) reported what appears to be the first pathological specimen of a ureterocele in a man aged 65, whose right kidney showed a constriction at the upper pole, forming a part of the kidney pelvis. The right ureter came from this constriction and ended in the bladder in a "cystiform projection." Since then similar postmortem cases bearing malformations related to ureteroceles were reported. Prominent among them are those presented, in chronological order, by Smith (2), Beach (3), Bostrom (4), Goerdts (5), Caillé (6), Ogle (7), Rott (8), and Otto (9).

Of the more recent cases, an excellent example of a large ureterocele without infection is the one reported by Furnival (10), who describes the anomaly as large as a pigeon's egg visible at the urethral meatus in a female, aged 16. Having examined a piece of the cyst, the pathologist stated that he was "confident the case was what H. Fenwick describes as 'ballooning of the ureteric orifice,' in which there is a narrowing, generally congenital, of the ureteral orifice that may be so minute that the pressure of the urine on the lower section of the tube swells out its termination into a bulb or cyst." Says Thompson Walker in his *Genito-Urinary Surgery*, 1904, under the heading "Congenital Narrowing of the Ureter," "I have observed congenital narrowing of the ureteric orifices in a man whose urinary system was otherwise normal. The finest ureteric catheter or bougie would not pass through the orifices."

Among others whose reports bear similar observations as to the primary cause of ureterovesical ballooning are Barringer (11), Martin (12), Furniss (13), and Eisendrath (14). The objection may be raised here that if ureteroceles are congenital, symptoms of obstruction should appear earlier. They do, as various cases of infancy on record, Bottomley (15), Johnson (16), Mutach (17), will attest. The ureterocystic dilatations free from symptoms until adult age is reached may be accounted for by the fact that all these cystic dilatations do not attain the same degree of stenosis. Also the wear and tear of the organism as age advances predisposes congenitally defective organs to changes in position and structure. In this respect it is not hard to picture a partially stenosed and dilated ureteral termination become the seat of further changes secondary to bacterial invasion of the kidney, ureter, bladder, or urethra. Thus the origin of ureteroceles which are said to be secondary to inflammatory reactions, such as the passage of a calculus into the bladder, renal tuberculosis, or bladder ulcerations is explained, Caulk (18).

But the thousands of renal calculi that have passed into bladders producing no ureteroceles is rather significant in this connection. Again, the well-known fact that any obstruction to kidney secretion predisposes to stone formation is not to be forgotten. It is more logical to think of a stone secondary to a ureterocele than the reverse. Those ureterocystic malformations attributed to inflammatory reactions are, the writer believes, simply ureteral meatus congenitally small but large enough not to cause urinary obstructions until complicated with infection. Were inflammatory conditions responsible for the presence of the anomalies in question, these conditions would probably induce genito-urinary symptoms or signs that would lead to their discovery before the ureteroceles would form.

Dardanelli (19), points out that a ureterocele is not merely a complication of hernia, nor the results of an operation, but in fact a hernia *sui generis* with a symptomatology and pathogenesis of its own. His observations show that the pelvic peritoneum is often very mobile and slippery, and that the ureters do not always follow a regular course toward the end but take a curved lateral direction.

The following cases are submitted as further evidence that the ureteral conditions in question are congenital.

CASE 1. M. L., age 39; June, 1917. Symptoms of 9 months' duration. Cystoscopy showed ureterocele of left ureter with a second ureteral orifice just above cyst. Operative recovery. Urine clear.

CASE 2. A. A., age 21; February, 1918. Symptoms of 2 months' duration. Cystoscopy detected a ureterocele of right ureter. Operative recovery. Patient perfectly well a month ago. Urine clear.

CASE 3. T. G. Z., age 34; May, 1916. Symptoms of 11 months' duration. Cystoscopy showed a ureterocele of the right ureter about the size of a hazel nut, and a stone in same ureter just above bladder. Operative recovery. Urine clear. Patient well today.

CASE 4. C. H. C., age 23; July, 1915. Symptoms of one year's duration. Examination revealed a calculus in urethra. Cystoscopy showed bilateral ureterocele. Operative recovery. Urine clear. Patient well 5 months ago; lost sight of since.

Cases 1, 3, and 4 were confirmed by Barringer. Cases 1 and 2 are typical ureteroceles without any inflammatory condition, while Case 2 has a third ureteral opening. The symptoms of Case 3 were entirely relieved by splitting the ureterocele, and the calculus was removed at a later date. Case 4, despite the removal of the urethral stone was not relieved of all symptoms until the ureteroceles were split open.

The number of ureteroceles associated with other anomalies is the most convincing evidence that these ureterocystic projections are of congenital origin. The writer has found in the literature 46 cases of ureteroceles in the living, and 17 in postmortem specimens, a total of 63 cases. Of these 32 were found with other malformations as follows:

In the living.

Ureter twisted in spirals above bladder	2	
A third ureteral opening	1	
Ectopic ureter	1	
Inguinal hernia of ureter	5	
Both ureters opened into bladder through diverticulum	1	
Left ureteral opening absent	1	
Kidney of same side lobulated	1	
Crural hernia left side	4	
Prolapsed ureter into bladder	4	20

Postmortem.

Lobulated kidney same side	1	
Bifid ureter	3	
Double ureters with atrophied small kidneys	1	
Ureters came from pelvis formed out of upper pole of kidney	1	
With third ureter	2	
Single kidney and one ureter which presented several spiral twists and communicated with the vas by a fine opening	1	
Kidneys without suprarenals, malformation of cloaca and pelvis, and absence of right ureter	1	
Reduplication of both ureters	1	
Both ureters from common pelvis and united by fibrous tissue to bladder, into which they opened by separate orifices	1	12
Total		32

SUMMARY AND CONCLUSION

A careful study of all the papers on ureteroceles from 1856 to the present day, together with the cases above reported, seems to warrant the conclusion that ureteroceles, found at birth and at all ages, about equal in number for both sexes, rarely bilateral and frequently associated with other anomalies, are congenital malformations.

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CYSTS AND FISTULÆ OF THE THYROGLOSSAL DUCT[1]

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EMBRYOLOGY

TO understand the pathology of the thyroglossal duct, one must be familiar with those parts of the embryo which enter into its formation.

In the human embryo the tongue develops, not as an organ of the mouth, but grows forward into the buccal cavity after appearing primarily largely in the pharyngeal region. The first distinct trace of the tongue is a rounded median elevation projecting from the depression on the floor of the pharynx between the ventral ends of the first branchial arches. This projection, the tuberculum impar (Fig. 1), enlarges and changes shape, forming eventually the anterior portion, about two-thirds, of the tongue. The posterior portion of the tongue arises from the ventral ends of the second pair of branchial arches and is at first separated from the anterior portion by a posteriorly directed V-shaped groove, traces of which persist in adult life. Meanwhile, a pouch-like depression develops below the angle of the V and later thickens to form a lobed mass. This thickening is the forerunner of a portion of the thyroid gland, and in its development elongates and constricts to form a stalked vesicle with its opening at first on the summit of the tuberculum impar. Under normal conditions of development, the hollow stalk of this vesicle becomes obliterated but remains as an epithelial cord for a short time after this change has occurred. This duct is the thyroglossal duct, and its former opening upon the tuberculum impar is in adult life represented by the foramen cæcum. The foramen cæcum is a portion of the duct, the length of which varies, which has not solidified and disappeared.

The lobed body destined to enter into the formation of the thyroid gland, following the obliteration of the hollow stalk or duct, migrates, passing ventrally and caudally to take up its position in front of the trachea (Fig. 2), leaving the foramen cæcum to mark its point of origin. In its migration this median thyroid anlage passes close to the developing hyoid bone and the latter structure not infrequently interferes with the passage of the vesicle, delaying or holding up portions permanently or causing deviation from the normal path.

In the normal human embryo, the duct begins to atrophy during the fifth week of intra-uterine life and is closed by the eighth week, except superficially, where it forms the foramen cæcum. However, remains of this fœtal channel are not uncommon, having been found in as many as 30 per cent of a series of bodies examined by one observer. It is readily seen, therefore, why a complicated course exists, if the stalk of the thyroid anlage fails to obliterate either wholly or in part. The tract would pass from the foramen cæcum on the posterior part of the tongue caudally and somewhat ventrally in the mid-line of the neck, either through the body of the hyoid bone or intimately connected with the periosteum and the thyrohyoid bursa behind the bone, then along the ventral surface of the upper portion of the trachea to the mid-portion of the thyroid gland. This course explains the difficulty which may be encountered in the surgical removal of lesions developing in this structure.

ANATOMY

The thyroglossal duct may be lined by one, two, or several layers of epithelium, more often ciliated (Fig. 3). In some examples, depending upon the amount of pressure to which the lining has been subjected in the recent state, the epithelium is flattened and, in areas, thinned out even to a loss of lining cells. In persisting remnants, which have become secondarily infected, the epithelial lining may be found in all stages of change as a result of inflammation.

In the walls of the persistent duct occur mucous glands usually of a simple type. The secretion from these assists in distinguishing cysts of this duct from dermoids with their dif-

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ferent type of content. In addition to mucous glands, it is not difficult to demonstrate lymph follicles scattered in the walls along the course of the tract. Of special interest, not only anatomically but clinically as well, is the occurrence or persistence of thyroid gland tissue along the course of the thyroglossal duct. This may be found at any point from the foramen cæcum downward, and is prone to occur where incomplete development of the thyroid in its normal position has taken place.

PATHOLOGY

While cases of persistence of the entire thyroglossal duct are recorded, they are much more rare than are lesions manifesting themselves in an isolated portion of the tract. Furthermore, while it is possible, theoretically, for any portion of the duct to persist and cause trouble later in life, either through cystic or solid growth formation, there exist apparently certain sites of election to which the majority of cases may be referred.

As is shown in the accompanying diagram (Fig. 2) the stalk of the thyroid anlage is brought into intimate relationship with the body of the hyoid bone during the migration of the structure to its position ventral to, or in front of, the trachea. The hyoid then forms one point of division, the duct or its remnant being closely associated with the body of the bone in the mid-line. Lesions developing from the portion of the tract extending from the foramen cæcum to the hyoid constitute the suprahyoid group, and those arising from the lower portion between the hyoid and the thyroid, the infrayoid group.

In Figure 4 (after Chemin) are shown sites of election along the upper and lower portions of the tract. There are five in all, three associated with the suprahyoid, and two with the infrahyoid portion. Practically all cystic lesions of this tract occur at one or another of these points.

There are three classes of lesions associated with the thyroglossal tract; first, the most common, the development of cysts, leading usually to the formation of fistulæ; second, the development of solid tumors; and third, the development of thyroid rests along the tract.

Thyroid gland tissue persists along the course of the thyroglossal tract, especially where incomplete development of the thyroid in its normal situation has occurred. These thyroid areas may develop at any point along the course taken by the original vesicle in its journey from the floor of the pharynx to the normal thyroid site. These aberrant thyroids have their origin in rests held up along the course and may present all the histological varieties of ordinary goiters. They are probably found more frequently in women than in men, their development is usually slow during the earlier years, more accelerated later, when the gland may increase rapidly in volume and interfere with phonation, respiration, or circulation. Such aberrant glands may undergo malignant degeneration. Their diagnosis is difficult, the microscope being the only certain test.

Numerous observers emphasize the importance of avoiding such thyroid tissue surgically if any doubt exists regarding the amount of thyroid present in the normal position. Delay in operation is advisable, as the main gland is usually underdeveloped, and the aberrant thyroid the source of supply of thyroid secretion. Cases are not rare where the removal of such tissue along the original stalk has been followed by functional disturbances attendant upon hypothyroidism.

Of the solid tumors associated with the thyroglossal tract, adenomatous and carcinomatous growths occur. Thyroid remnants persisting along the tract are subject to pathological changes similar to those affecting thyroid tissue in its normal position. Changes of the latter type are more common in women than in men and are apt to occur in early life, often about puberty, and in these patients there are often disturbances of menstruation in addition to local symptoms.

Cysts of the thyroglossal duct are the lesions commonly resulting from a persistence of the structure, either in part or entire. Often the patient when first seen by the physician presents a sinus, but this has in all cases been preceded by a cystic swelling, which has either ruptured spontaneously, or has become infected and been opened under a mistaken diagnosis.

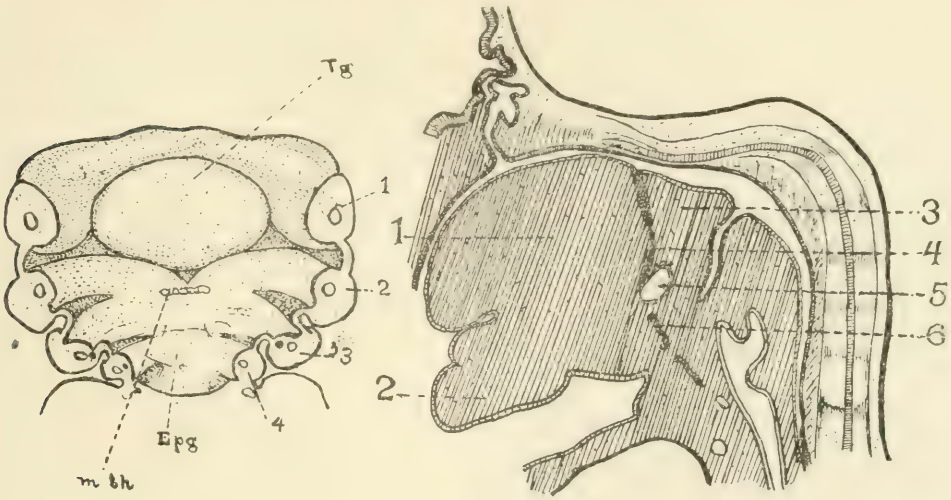


Fig. 1. Reconstruction of pharynx of human embryo. *Tg.*, tongue; *1*, *2*, *3*, *4*, branchial arches; *Epg.*, epiglottis; *m. th.*, median thyroid anlage. (*His*).

Fig. 2. *1*, Anterior portion of tongue; *2*, inferior maxilla; *3*, epiglottis and base of tongue; *4*, suprahyoid portion of thyrolingual duct; *5*, hyoid; *6*, portion of duct below hyoid. (*His*).

The essential structure of cysts of this type is quite constant (Fig. 3). The wall consists of consecutive layers of connective tissue, delicate and transparent in those of small size with little or no inflammatory reaction present. In the larger cysts and in those which have become infected and have undergone an intercurrent inflammatory process, the fibrous wall may be thickened, dense, and compact with cellular infiltration. Blood-vessels are usually numerous and course about the cyst between the layers of fibrous tissue. Even in the small cysts the vessels may be of considerable size and often lead to profuse hæmorrhage during the course of removal. In addition to the vessels, groups of mucous glands are often observed here and there in the sections and isolated gland structures are scattered throughout the walls. The epithelial lining of cysts arising from this structure tends to vary in appearance at different points of the cyst wall. The cells are from two to three to several layers thick, are more or less flattened, depending somewhat upon the age and degree of distention by secretion. From the free surface, cilia project and are readily demonstrated, provided no destructive action has occurred within the cyst. In cysts, which have not been subjected to inflammatory changes the content is a fairly viscid mucus, colorless and faintly turbid from cell detritus. At times this mucus is discolored by pigments resulting from hæmorrhage into the cyst.

In cysts which have undergone inflammatory reaction the walls are thickened, glandular structures distorted, lining epithelium modified or destroyed, and the contents changed, depending upon the severity and chronicity of the reaction. Infection of thyroglossal cysts frequently occurs "spontaneously" by means of the hæmatogenous route as well as after rupture or opening and draining.

Thyroglossal cysts are present in the mid-line of the neck or tongue along the site of the original tract differing from lesions of the branchial clefts, which are lateral in their situation. The time of appearance further distinguishes between these lesions, the thyroglossal cysts never being congenital as is the case of the latter. They may appear at any time after birth from the earliest months to adult life, when in response to unknown factors the cystic dilatation first manifests itself.

As was mentioned above a cystic swelling always precedes sinus formation. The cyst may rupture spontaneously, the skin opening occurring singly and usually in the mid-line of

the neck in front of the trachea. The opening may be found at any point in the mid-line between the hyoid bone and the suprasternal notch, although it may be a short distance to one or the other side of the mid-line. In the case of cysts of the upper portion of the tract, rupture at times takes place into the mouth through the foramen cæcum. Occasionally a passage will extend from an opening at the base of the tongue to a second in the mid-line of the neck with drainage at times both into the mouth and upon the anterior surface of the neck. The level at which the opening occurs in the neck depends upon the distance downward to which the cystic dilatation has dissected along the planes of the neck before the pressure or pressure plus infection overcomes the resistance of retaining structures.

The size to which thyroglossal cysts develop varies greatly and depends in part, at least, upon their location, the course taken in their development, and the absence of infection. In addition to the frankly cystic or clearly patent portion of the duct, a less obvious fibrous extension usually exists. This is a minute threadlike portion of the tract attached to one pole of the cyst. This tract is entirely obliterated and persists as a fibrous cord connecting the dilated portion to the hyoid body or extending on upward to be lost among the tissues in the base of the tongue. Unfortunately, at times the persistence of a minute lumen extending to, into, or even through, the body of the hyoid in the mid-line is overlooked and leads to a recurrence after removal of the obvious lesions. Removal of the cyst, or the resulting sinus and the tissues along the site of the original duct, including the mid-portion of the hyoid bone, is the only procedure that will surely lead to a complete cure of the condition. As many as eight operations by surgeons of experience have been reported before a cure resulted.

CASE REPORTS

Case 1. Type 1. Patient a Filipino girl of about 18, who came complaining of a feeling of fullness and stiffness at the base of the tongue, increasing difficulty in articulation and swallowing. The trouble has been noted for the past 6 months.

General examination and history, negative. At the posterior portion of the tongue, projecting slightly, was felt a smooth, rounded, elastic tumor. It occupied the area below the position of the foramen cæcum. With the tongue pulled well forward, and using a mirror, vessels could be seen coursing over the surface of the tumor and a pale, grayish-colored, and semitransparent wall determined a cystic, rather than a solid growth. This cyst was enucleated through the mouth with some difficulty and considerable bleeding. It was thin walled and contained a thick, glairy, fairly clear fluid, which was sterile.

Cases 2 and 3. Type 2. These occurred in Filipino women between 25 and 30 years of age. In the first case the cyst measured about 6 centimeters in diameter, it elevated and prevented protrusion of the tongue, and interfered markedly with speech. The patient had been conscious of the swelling for about 2 years. Removal of this large cyst was accomplished only after evacuation of the contents, a turbid, mucoid fluid stained dark yellow-brown by blood pigments. A fibrous tract extended into the mid-portion of the base of the tongue and was followed and removed well up toward the foramen cæcum. The operation was done through a median incision extending from below the chin to the hyoid.

The second of these two cases was of a smaller cyst in the same location, not giving rise to any complaint, but found during the course of an examination of an emaciated woman. The cyst, 3 centimeters in size, shelled out readily, and a cone-shaped extension directed toward the base of the tongue in the mid-line was traceable for but a short distance. The cyst and contents were typical of thyroglossal dilatations.

Case 4. Type 4. An American girl of 16, came to the Nose and Throat Clinic at Stanford University Medical School, complaining of a swelling in the mid-line of the neck, which had appeared 3 years previously, at puberty. The patient was kindly referred to me by Dr. E. C. Sewall. The swelling measured 4 centimeters in diameter, was situated in the mid-line just below the level of the hyoid bone, and was tense and elastic. The overlying skin was free and had undergone no change.

On enucleation the cyst was found to be thin walled, was firmly attached by a fine tapering prolongation that entered the lower border of the hyoid bone, necessitating the removal of the lower portion of the mid-part of the bone. The walls of the dilatation were smoothly lined with somewhat flattened epithelium which was ciliated in places and contained a slightly turbid mucoid fluid.

Case 5. Type 5. An American woman of 20, an only child, married, referred to me by Dr. C. D. Sewall. Her menses began when she was 15, their onset was accompanied by severe pain, and at this time a swelling appeared in the region of the thyroid gland and caused pain locally; following which her eyes gradually became prominent. Later the swelling presented signs of inflammation of varying intensity and some months afterward perforated, giving rise to a median sinus midway between the

level of the hyoid bone and the suprasternal notch. This opening healed over later and for some months the patient was well; then the swelling, inflammation and perforation recurred. This was repeated four times at varying intervals, three swellings perforating externally at the above mentioned point, one into the mouth at the base of the tongue. The patient described the exuded material as being yellowish white in color, creamy in consistence, and in large amounts. Following each spontaneous opening of the swelling the sinus discharged a turbid, mucus-like material for varying periods. The patient had been told she had an abscess of the thyroid gland.

When coming under observation the patient presented a dimpled scar about 1.5 centimeters in diameter in the mid-line of the neck about the level of the thyroid isthmus. The dimple in the center of the circular area led to a small opening, which just admitted a fine probe. The scar and skin about it were reddened and thickened. For several months the patient had been obliged to wear a dressing to collect the whitish, rather turbid mucous secretion. A fine probe passed into the opening showed the tract to extend upward in the mid-line of the neck for about 4 centimeters and downward below the level of the opening about 1.5 centimeters into what was evidently a saccular dilatation lying in front of the trachea. At operation a sac with thickened, fibrous walls was dissected from in front of the trachea and beneath the pretracheal group of muscles. The sac measured 2.5 centimeters in diameter, was elongated, and extended down behind the manubrium. Traction downward upon the freed sac brought into view a cord-like extension passing up the mid-line of the neck to within 2 centimeters of the hyoid bone where it deviated slightly to the right of the mid-line, passed just posterior to the body of the hyoid and became apparently fused with the cricothyroid membrane. The finest probe could not be passed more than one-half the length of this cord and above the body of the hyoid no trace of the tract could be found. The patient has remained well for over 2 years.

Case 6. Type 4. An Italian, male, age 24, enlisted as mess attendant in the United States Navy in 1917. In December of that year he first noticed a swelling in the mid-line of the neck at about the level of the hyoid bone. He complained of pain, which, for several days, was enough to interfere with swallowing. Following cold applications the original swelling, which had been more diffuse, localized to form a firm tense elevation in the mid-line of the neck about 3.5 centimeters in diameter, over which the skin became reddened. This condition was regarded as an abscess and was incised, and a thick, straw-colored fluid evacuated. The cavity was packed and drained for 5 days, after which time the wound healed and remained closed for about a week. Swelling recurred, and the cyst opened spontaneously with the discharge of more straw-colored, thick material, and for a period of 5 months, in spite of repeated cauterizations, packing and drainage, it remained open and discharging. The discharge had no odor but the amount required daily change of a small pad.

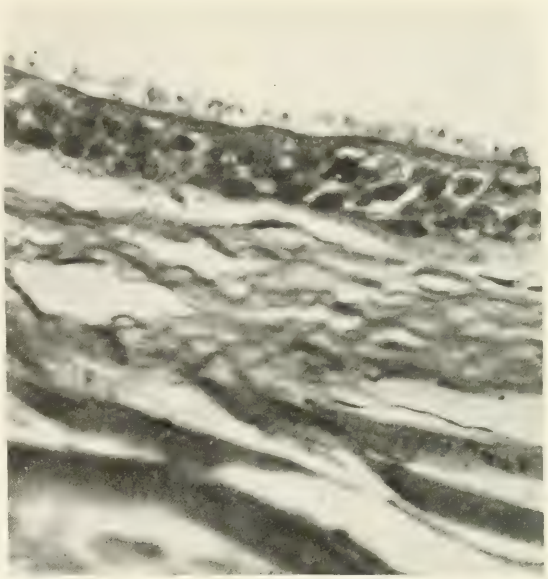


Fig. 3. Photomicrograph of thyroglossal cyst.

When first seen the patient showed a central opening in the neck about 2 centimeters below the level of the hyoid. There was a discharge of pale, turbid mucus containing many leucocytes. A fine probe passed up the tract to about the position of the mid-point of the hyoid body.

At operation a tubular structure was exposed, extending from the sinus upward in the mid-line to the body of the hyoid where it apparently became fused with the periosteum posteriorly, and was lost. The lumen extended almost to the lower border of the bone. This channel was removed, but the body of the hyoid was left undisturbed.

Following this operation the patient remained well for about 3 months when the central portion of the transverse neck scar ruptured and a thick, mucopurulent material escaped. This continued to discharge for about 3 weeks, when a second operation was done, the mid-portion of the hyoid bone removed, and a mass dissection made well up to the under surface of the tongue, including the tissues in the mid-line. The patient has since remained well.

Case 7. Type 4. An American negro private, age 24. In November, 1918, after 3 months in the trenches in France he noticed a small, slightly tender swelling in the mid-line of the neck. This gradually increased in size but never became more tender. He was told that the swelling was an enlarged gland, and it was treated with applications of tincture of iodine. When the patient was seen some 3 months later, the swelling, as shown in Figure 5, was prominent, having increased greatly in size. At this time

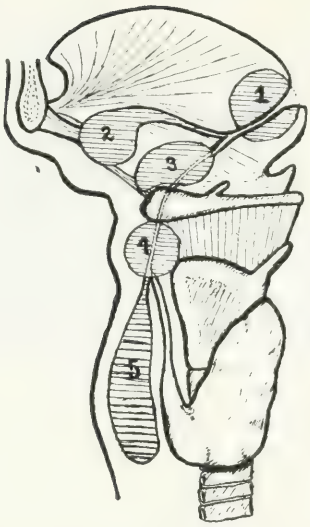


Fig. 4. Showing sites of election along the upper and lower portions of the thyroglossal tract. (*Chemin.*)

Fig. 5. Case 7 showing the prominence of the swelling.

the entire neck was somewhat painful, the swelling itself quite tender, was tense, elastic, and apparently not connected with the overlying skin. The throat examination was negative. Unfortunately the conditions under which the patient was seen precluded a complete operation, so to relieve his discomfort the cyst was incised and a large amount of turbid, mucoid fluid was evacuated. This fluid showed degenerating epithelial cells, round cells in addition to numerous leucocytes and a granular detritus. The cavity of the cyst was lined by smooth walls, which constricted above to form a more or less funnel-like upper portion. This patient was lost sight of.

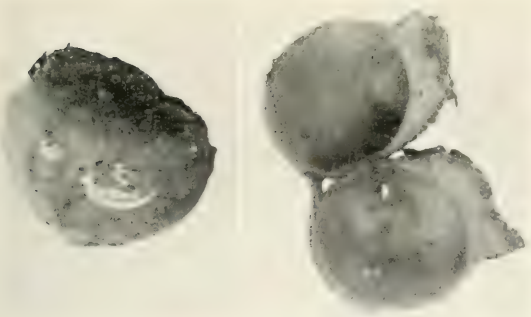
Case 8. Type 1. An American child, age 3½ years. The parents of this girl noticed lately that she did not articulate distinctly, that her appetite was poor, due apparently to some difficulty in swallowing and that she was a mouth breather. After being seen by several physicians she was brought to Dr. E. C. Sewall, with a diagnosis of lingual tonsil, in addition to enlarged tonsils and adenoids. Dr. Sewall performed a tonsillectomy, and kindly referred the case to me. Examination showed a round, elastic tumor, about 2 centimeters in diameter, at the base of the tongue below the foramen cæcum. The rounded surface of the swelling was smooth and shining, and blood vessels could be seen in its wall. There was no inflammatory reaction about its periphery. With one finger in the mouth and one on the hyoid bone the swelling could be felt as a tense, elastic, rounded mass, apparently in intimate relation with the body of the hyoid bone. At operation through a transverse collar incision the cyst was exposed, after separating the myohyoid and geniohyoid muscles and exposing the space beneath the base of the tongue. A finger in the mouth pressed the tumor downward and outward, and the cyst was freed by blunt dissection and separated everywhere except from the mucous membrane over the portion presenting at the base of the tongue. This mucosa was so thinned out and intimately blended with the cyst wall that it was removed with the cyst, and the wound in the tongue brought together with interrupted sutures. The space beneath the tongue was obliterated, the wound closed in layers, and a small drain was inserted for 24 hours. The wound healed promptly, and immediately there was improvement in the general condition, in addition to that of appetite, swallowing, and speech.

The photographs prepared by Dr. F. E. Blaisdell (Figures. 6 and 7) show the general appearance of this cyst. The microphotograph (Fig. 8) shows the structure of its walls.

Case 9. Type 4. An Italian girl, age 8, who complains of a swelling in the neck. The child's mother had noticed a lump under the chin practically since birth. The lump had never been painful, had never disappeared, but had increased steadily in size. The child has never suffered from sore throat, nor has the skin over the swelling ever been reddened.

Situated in the mid-line of the neck, about half way between the point of the chin and the hyoid bone was noticed a round, smooth swelling about 2.5 centimeters in diameter. The skin over this was unchanged and not attached, the swelling being quite freely movable laterally, but being fixed when movements up and down were attempted. It could not be raised away from the region of the hyoid bone. The swelling was smooth and gave one the impression of elasticity. The general examination of the child was negative, except for the foramen cæcum, which was quite prominent and fairly deep. The child experienced some difficulty in swallowing.

Through a transverse collar incision over the most prominent portion of the swelling, a thin walled,



Figs. 6. and 7. Case 8. Gross specimen of cyst and hemisected specimen.

fairly smooth cyst was exposed with several good sized vessels coursing over its surface. The cyst was isolated from the surrounding tissue by blunt dissection and partially delivered from the wound. This step exposed a funnel-shaped prolongation, extending upward for a short distance in the mid-line, in the general direction of the hyoid body. This prolongation was followed until it was lost and the cyst removed entire. The pathological report rendered by Dr. Blaisdell at Stanford University Medical School states that the wall of the cyst is composed of fibrous tissue, lined on inner side by layers of flattened epithelium in places ciliated.

Case 10. Type 4. Patient is an adult Japanese referred by Dr. M. E. Rumwell. He noticed for the past two weeks only, a swelling of his "Adam's apple". This swelling has not been painful nor has the skin over it changed nor has the patient felt any discomfort on swallowing.

Examination shows a rounded, elastic swelling in the mid-line between the hyoid bone and larynx which swelling moves upward and downward on swallowing, is not attached to the overlying skin, fluctuates, and is definitely a cyst containing fluid under a fair degree of tension. Examination of throat and a general physical examination negative.

Operation through a transverse collar incision exposed a thin walled cyst which was found attached to a pedicle extending upward beneath the hyoid bone. The cyst contained a yellowish, gelatinous fluid and was removed with difficulty, being quite adherent to the surrounding structures. The pedicle was treated by wide excision.

DIAGNOSIS AND TREATMENT

Occurring in a tract lined by cylindrical or flattened ciliated epithelium, with a mucous secretion, cysts of this structure are mucous cysts. Trauma and infection modify their appearance greatly.

Persistent portions of the thyroglossal duct may remain quiescent for years and announce

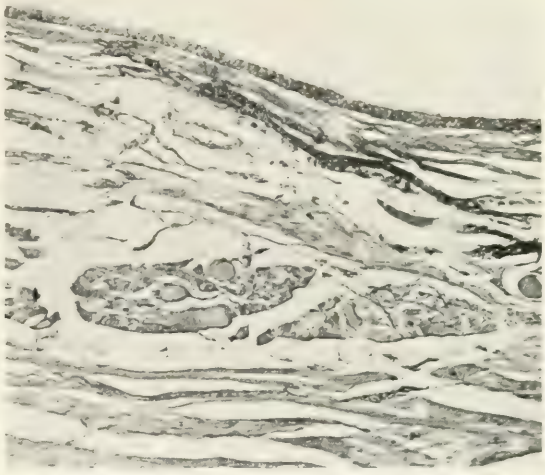


Fig. 8. Photomicrograph of cyst in Case 8.

their presence either by some acute inflammatory process with symptoms similar to those caused by an acute phlegmon or by a small swelling that increases steadily in size, the rate of this increase varying, however, within wide limits. Cysts of small size may give rise to no symptoms and at times are only discovered in the course of a routine examination.

The location of the primary lesion is in the mid-line of the neck or tongue along the pathway of the original embryonic duct. At times the superficial appearance of the lesion may be lateral, the cystic dilatation of the tract being uneven. If suppuration occurs and passes through the wall, suppurative exudate may burrow along the planes of the neck to almost any position. This explains the cases of lateral fistula, the suppuration having reached the surface of the neck to one or the other side of the mid-line. Suppuration of the thyroglossal duct presenting as an abscess above the sternum is at times misinterpreted, opened locally, and results in a persistent sinus.

Cysts may remain small for years, increase rapidly in size for a time, then remain quiescent. Others rupture either upward, discharging their contents through the base of the tongue into the mouth, or outward through the overlying structures on to the neck forming a cervical sinus which is never congenital,

always single, and has been preceded by the swelling. These fistulæ may close but practically never remain so. They reopen and discharge a mucous or purulent exudate. The fact that cysts and their resulting sinuses are never congenital, though they may appear at any time after birth helps to distinguish them from cysts of branchial cleft, which are congenital and lateral in their situation. Thyroglossal abnormalities are apparently more common in women than in men, and, while they may manifest themselves at any age, are more frequent in the first 20 years of life.

Cysts of this tract differ from soft vascular thyroid remnants in being more tense and elastic. At the base of the tongue the light color projected through the thinned-out mucosa over a cyst is in definite contrast to the dark red or purplish appearance of a misplaced thyroid. In the floor of the mouth greater diagnostic difficulties are encountered at times as other cystic lesions are not uncommon here. It may be that exposure of the cyst or even sections are necessary to allow a positive differential diagnosis. Dermoids offer the least difficulty as, from the different nature of their contents, they are less transparent and more doughy than are the uninfected thyroglossal cysts.

In the neck, sebaceous cysts have given rise to confusion at times but these are above the muscles and adherent to the skin. In like manner a cold abscess might cause difficulty but these are less circumscribed and lateral. Suppurative tuberculous glands if isolated might and indeed have been a source of error, though this condition is not often met with in the mid-line.

The symptoms associated with cystic lesions of this tract depend upon the location of the swelling and the structures subjected to pressure by it. Difficulties in phonation, deglutition, and respiration may be present singly or in combination. In many cases the swelling alone is complained of.

TREATMENT

The treatment of cysts and sinuses of the thyroglossal duct is complete excision. If the course taken by the median thyroid anlage be understood and borne in mind, the complete removal of the lesion should not offer great difficulties. A cystic dilatation of a portion of the tract often communicates by a fine aperture with a portion of the duct, and unless this is also removed completely recurrence is certain to occur. Sinuses likewise connect with a narrowed portion of the tract that is too small to allow the passage of the finest probe. In one case we endeavored to inject the tract with an aniline dye solution, but found this to be not entirely satisfactory.

Except in cases of small cysts below the foramen cæcum, the route through the neck is preferable for the removal of lesions of the duct. Small cysts easily shelled out from the base of the tongue may be removed through the mouth, although by this method of approach one cannot be positive that all the persistent duct has been removed and future trouble avoided.

Certainly in all but small cysts at the base of the tongue and for all lesions lower down, the course of the original tract, the approach through the neck exposing completely the path from the tongue base to thyroid isthmus is to be preferred.

A transverse collar incision situated at the level best meeting the requirements gives a good exposure upon dissecting back the flaps above and below. If the case be one of cyst, this is freed as completely as possible by shelling out; if of sinus, the opening is freed with as much of the surrounding skin as may be deemed necessary. Traction is then employed, the pull causing the upper portion of the tract or sinus to stand out. It may then be followed by blunt dissection after separation of the neck muscles toward each side away from the median line. In following up a cord under tension from below the hyoid bone, it is important to determine, if possible, the fate of the tract at this point. If the cord is seen extending upward above the hyoid the only safe course is to remove the mid-portion of the bone and continue the uninterrupted dissection upward well to the base of the tongue. In no other manner may one be certain the tract has been eliminated. If the cord is lost well below the level of the hyoid, it is justifiable to omit removal of the

central portion of the bone. The cases presenting the greatest difficulty of decision are those in which the upward prolongation from a cyst or sinus extends well up toward the lower border of the hyoid body in the mid-line, then merges with and becomes firmly attached to the periosteum spreading out over the inferior and posterior surface of the bone. At times it is possible to hook upward and forward the bone and dissect the tract from its posterior surface.

Because we had a recurrence in one case where the hyoid mid-portion was not removed and where the tract apparently merged with the periosteum over the inferior surface of the body, we believe in all cases where any doubt exists it is best to remove a narrow central portion of the bone and extend the dissection of the tract upward, as destruction or removal by anything short of complete excision is useless and removal of the middle portion of the hyoid is followed by no disability.

The neck approach in cases of lesions below the tongue and also in the base of that organ gives a good view of the field and allows complete removal of the area containing the pathway of the original tract. The base of the tongue is readily reached through a collar incision followed by separating the several layers of muscles in the median line. This exposes a more or less definite space beneath the tongue occupied by fatty and loose areolar tissue. Advantage is taken of this space to project the cyst forward and downward into it by means of an assistant's finger in the mouth pressing upon the cyst above. The cyst may then be shelled out and any projections followed up and removed.

CONCLUSIONS

1. Lesions due to the persistence of a portion of the thyroglossal duct are not rare and must be considered when attempting a differential diagnosis of abnormalities occurring along the course taken by the thyroid anlage from the base of the tongue to the region of the thyroid isthmus.

2. Thyroglossal lesions occur in the mid-line of the tongue or neck.

3. Median cervical sinuses occur singly, are never congenital as is the case in branchial cleft conditions, which moreover are lateral in their position, though the median lesions may appear at any time after birth.

4. Median cervical sinus is always preceded by a swelling which ruptures or is opened by the surgeon under mistaken diagnosis, and which never closes permanently. Mucus is discharged unless it becomes purulent through infection.

5. Cysts of this structure show certain points of election and their contents vary somewhat according to their age and the predominence of certain elements in their walls.

6. Thyroglossal lesions are more common in women than in men and in the first twenty years of life.

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THE OPERATIVE TECHNIQUE EMPLOYED IN THE CLOSURE OF AN EXTENSIVE VESICO-URETHRO-VAGINAL FISTULA[1]

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THE following case is reported because of the difficulties encountered due to extensive loss of tissue, the result of numerous futile attempts at repair, and because in all such cases no set method of procedure or technique can be depended upon on account of the varying conditions to be dealt with. The improvization of technique necessary may be of value to others in stimulating and guiding their ingenuity in solving similar problems.

No more distressing and pitiful sufferers appeal to us for aid than these poor women who have gone through repeated operations only to be increasingly disappointed as hope becomes less and less after each failure.

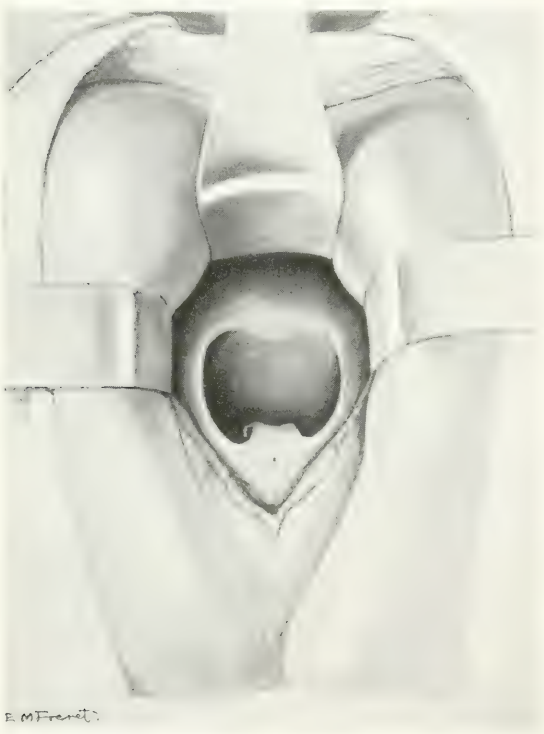

Fig. 1. Showing loss of tissue in vesico-urethro-vaginal fistula.

As it was the cry of these sufferers for help some sixty-five years ago that led to the birth of gynecology as a specialty, so today, although they are not so numerous, there are still sufficient of these disappointed ones seeking aid, to emphasize the need of special men devoting their energies to this special surgery.

Mrs. M. S., age 29, came under my care at the Woman's Hospital in May, 1919, complaining of complete inability to hold the urine since an instrumental delivery 4 years previously. She had been married 11 years. Ten years ago, when 7 months pregnant, she was delivered with instruments of a stillborn child. She was lacerated and repaired. The exact nature of the labor is unknown but she was in bed for 1 month. She then had seven spontaneous miscarriages in the next 6 years of from 2½ to 5 months' duration, with curettage after each. On December 8, 1915, when 6½ months pregnant with twins, the membranes ruptured spontaneously and an instrumental delivery was performed. On the seventh day postpartum urine flowed continuously from the bladder. Two months later an unsuccessful attempt was made to close the opening in the bladder, and in the following 4 years thirteen unsuccessful attempts were made by three different surgeons. Three years ago, during one of the attempts, an abdominal hysterectomy was done, but for what reason it has not been possible to ascertain.

Fig. 2. Patient in Bozeman's position, with hips markedly elevated.

[1] Read before the American Gynecological Society, Chicago, June, 1920.

In addition to the continuous escape of urine, the the patient complained of burning pain in the vagina and vulva and above the pubes, with constant distress from the extensive excoriations which were over the vulva and thighs.

The patient was a well developed woman, 5 feet 5 inches in height, weighing 150 pounds, and in good physical condition other than her local disability. The examination showed the external genitals and the vagina œdematous, red and excoriated, with numerous phosphatic deposits embedded deeply in the tissues. The entire anterior vaginal wall was absent, the base of the bladder being completely gone with the ureters opening into the vagina. The vaginal margins of the fistula were very much inflamed and bled easily to touch. The urethra was absent with the exception of a small thin quadrangular flap of tissue one-half to three-quarter inches in length which hung dependent from the vestibule and which was perforated by the external meatus. The cervix had apparently been amputated at some time independently of the hysterectomy, evidently a supravaginal operation, as a stump could be palpated above the flush vaginal vault. The pelvic floor was moderately relaxed. To cure this large vesico-urethro-vaginal fistula with loss of the urethra seemed a well nigh hopeless problem in view of the extensive loss of tissue (Fig. 1).

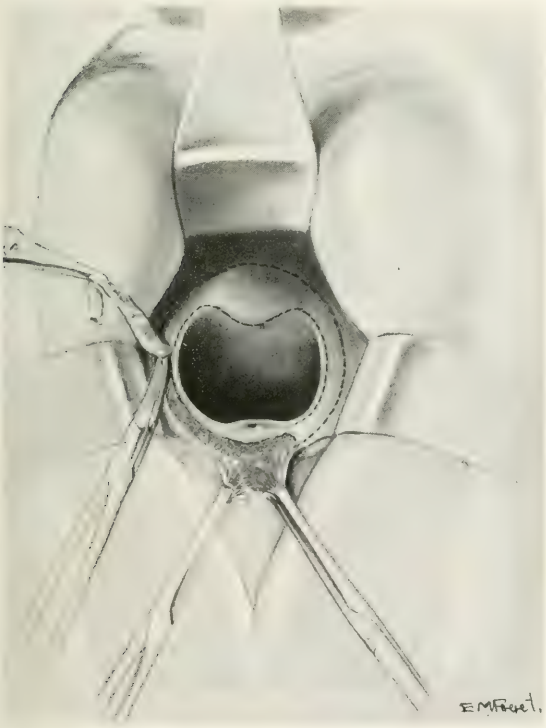

Fig. 3. Excision of strip of tissue around edges of cavity.

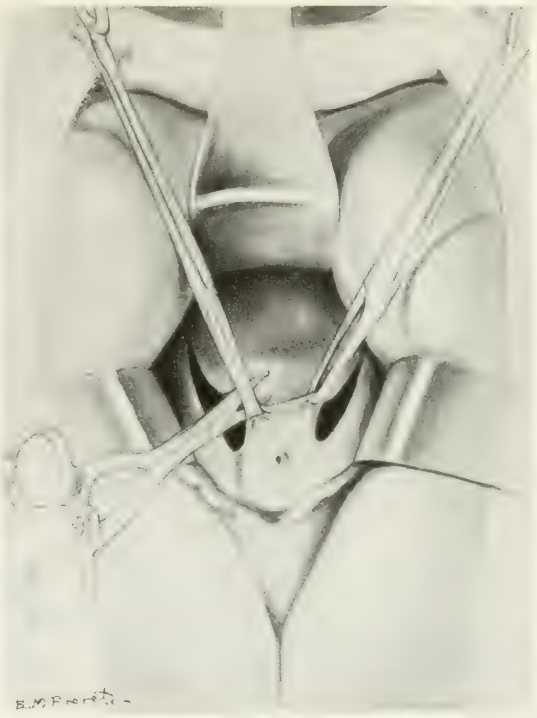

Fig. 4. Traction applied with bullet forceps to cervical stump and toward urethra changing fistulous opening from O to U shape.

It was obviously impossible to attempt any operative procedure until the inflamed condition of the parts was cleared up and the phosphatic deposits removed. The patient was kept in bed and treated by means of hot douches and boroglyceride packs. Zinc oxide ointment was used externally. The patient was also given the preparation so successfully used by Dr. Thomas Addis Emmet to render the urine acid and to prevent the formation of phosphatic deposits: 1 dram benzoic acid, 2 drams sodium borate in 8 ounces of water, given in water, one tablespoonful three times a day, and reduced to 1 dram after 4 days.

The removal of the phosphatic deposits was an extremely painful process. It was necessary repeatedly to anæsthetize the patient to allow of this being done properly. This course of preparatory treatment lasted for a period of 6 weeks when the inflammation finally subsided.

On July 7, 1919, the patient was operated upon.

She was placed face downward in Bozeman's position, with the hips markedly elevated. A large vaginal retractor was inserted and the perineum retracted upward. This position insures a complete ballooning of the vagina and of the bladder and allows

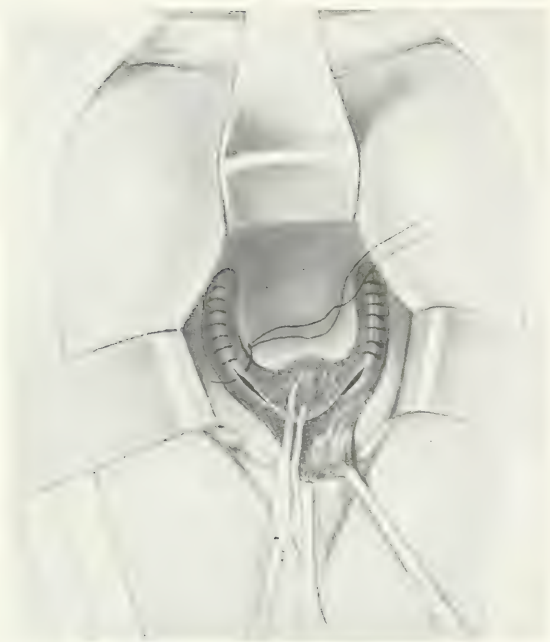

Fig. 5. Edges of denudation closed by interrupted sutures of No. 1 catgut, and silkworm-gut sutures.

Fig. 6. Quadrangular flap at site of urethra sutured over the denuded cervical stump.

the blood to run into the bladder thus facilitating the operative work. I consider this posture of the greatest value in this type of case, and that it is one of the prime factors in the result obtained (Fig. 2).

The ureters were probed to establish their location so as to avoid injury. With scissors a strip of tissue from one-half to three-fourths of an inch wide was excised completely around the edges of the cavity, extending across the site of the stump of the cervix, which had been amputated, and also extending on the inner surface of the quandrangular flap at the site of the urethra (Fig. 3).

The cervical stump was grasped with a bullet forceps and traction toward the urethra made easy the approximation of the tissues lateral to the cervical stump, throwing the margins of the fistula into angles in the lateral fornices, so that the fistulous opening originally shaped like the letter O now became shaped like the letter U (Fig. 4).

The vesical edges of each angle were then closed by interrupted sutures of No. 1 tanned catgut. A second layer of interrupted sutures of silkworm-gut was passed through the vaginal mucosa and the denuded area on both sides, and the ends left long and tied together. The quadrangular flap at the site of the urethra was placed over the denuded stump of the cervix and sutured in a similar manner (Figs. 5 and 6).

The result of this operation was a complete closure of the defect without tension.

A self-retaining catheter was inserted into the bladder through the urethral meatus and the bladder was washed out with boric acid solution. Great care was taken to wash out the catheter daily with a syringeful of boric solution to keep it clear and clean, and the catheter was changed every 4 or 5 days. It was retained for 12 days, at which time the sutures were also removed.

The wound healed by primary union and is entirely closed except a small pin point opening on one side of the meatus. The result is most satisfactory; although patient has no vesical sphincter she is able, in erect posture, to retain the urine without leakage for a period of 2 to 4 hours; at night she can go considerably more than 4 hours, depending upon quantity of urine being excreted.

VESICO-APPENDICEAL FISTULÆ

Report of Two Cases

By F. W. RANKIN, M.D., and E. S. JUDD, M.D., F.A.C.S., Rochester, Minnesota
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FISTULOUS communications between the bladder and various portions of the intestinal tract occur with relative infrequency, and give rise to definite and distressing symptoms. The openings are usually between the sigmoid flexure of the colon and the bladder, although the descending colon, cæcum, and small intestine have been reported found attached to the bladder. The anatomical relationship between the sigmoid and the base and left wall of the bladder and the fact that the sigmoid is most often the site of diverticulitis or malignant disease are responsible for the frequent occurrence of fistulæ in this region. A normally placed cæcum does not approximate the bladder, but because of elongation of the mesentery or ptosis of the cæcum from various causes it may rest in the pelvis, and if the appendix is inflamed it may easily become adherent to the bladder. Progression of the process leads to perforation and the resulting vesico-appendiceal or vesicocæcal fistula, depending on whether the appendix ruptures and a local abscess results or merely the lumen of the appendix communicates with the bladder. That the communication may be incomplete and not permit the passage of fæcal particles or seeds is demonstrated by our first case, in which cystoscopic examination revealed an ulcer of the bladder but no fistula, and transperitoneal exploration of the bladder showed a stump of appendix attached to the vesical wall opposite this site so that there was no doubt as to the etiology. Cunningham and others have observed fistulæ between the bowel and bladder due to perforated areas. At present one such case is under treatment in the clinic: a carcinoma of the sigmoid which was explored and in which a radical extirpation was inadvisable because of the attachment of the growth to the bladder and pelvic wall and because of metastasis in the liver. The patient developed a vesico-sigmoidal fistula within 2 months after operation.

In a recent case the small bowel was found attached to a carcinoma of the dome of the bladder which otherwise appeared operable. A resection of bladder and bowel was performed and the patient made a good operative recovery.

In a small percentage of cases the urogenital sinus fails to close and the base of the bladder communicates with the rectum, the ureters emptying directly into the bowel. Four months ago a boy of 17 presented himself at the clinic in this condition. A perineal section and closure of the fistula was successful.

The principal symptoms of a fistula between the bowel and bladder are pneumaturia and the passage of fæcal material, seeds, and undigested food particles by urethra. The histories of our cases, and of those which we have found reported, are very similar, that is, an attack of acute abdominal pain radiating into the pelvis, followed by passage of gas and food particles. Cloudy urine infected with colon bacilli is present almost from the onset. The infection may be cleared up post-operatively by the use of lactic acid bacilli and irrigations with aluminum acetate solution.

Pilcher reported a case which came under his observation in 1912, in which food particles appeared by urethra within 15 minutes after ingestion. This case was complicated by vesical stone for which a suprapubic cystostomy was performed, but a fistula connected with the bowel was not demonstrated. A later operation, however, for return of symptoms revealed the condition.

In one of our cases cystoscopic examination failed to reveal a definite communication, but the diagnosis of areolar cystitis seemed to warrant an exploration, and the fistula was found and repaired. That the fistulæ are somewhat incomplete or at least too small

Fig. 1. Ileocæcal coil showing the appendix attached to the posterior wall near the dome of the bladder, the lumen of the appendix communicating with the interior of the bladder.

to permit the passage of food particles seems an explanation of this symptom, for the passage of gas bubbles with urination is practically constant.

Lauterman, in 1916, reported an interesting case of a young man who came to him with acute urinary obstruction due to a grain of Indian corn impacted in the urethra. After removal of the corn with a urethroscope, on cystoscopic examination, a catheter was passed into the fistulous opening and into the right ureter.

Case A258012, L. W. Q., a man aged 36, entered the clinic January 27, 1919, complaining of frequency and burning on urination, of 7 years' standing. At times the condition was aggravated and the patient had been compelled to void every 10 minutes day and night; at other times the symptoms were entirely absent. Cystoscopic examination had been made three times in the 6 years. Twice a diagnosis of enlarged prostate had been made, and on one occasion, diverticulum of the bladder. No difficulty had been experienced in starting the urine, and for 5 years there had been no hæmaturia. Two months before the patient was admitted to the clinic, following an attack of influenza, he had had dull pain over both kidneys. A cystoscopic examination was made February 24, 1919, and areolar, ulcerative cystitis of the dome of the bladder and chronic prostatitis were found. The 12-hour specimen of urine, 1,050 cubic centimeter, had a specific gravity of 1.012, it was acid in reaction, negative for sugar, albumin 2, and pus cells 3 on a scale of 1, 2, 3, and 4. The blood pressures were 118 and 78. X-ray examination of the urinary tract was negative. The combined functional test January 1, 1919, revealed a total of 300 cubic centimeters, 45 per cent in 2 hours and 15 minutes. An exploration was advised, and March 21, 1919, the bladder was opened through a suprapubic incision. The ulcer which had been seen with the cystoscope was found to communicate with the bowel close to the ileocæcal valve and apparently the old stump of the appendix. The peritoneum was opened and the ileocæcal coil dissected free. A definite opening in the cæcum near

the ileum was closed. The last 18 inches of small bowel were knotted and indurated, and showed marked evidence of inflammation. The raw peritoneal surfaces of the bowel were covered as well as possible and a Witzel enterostomy performed about 5 inches above the indurated small intestine. The opening in the bladder was closed from the peritoneal side; a tube drain was left in the bladder.

The operative diagnosis was vesico-intestinal fistula, resulting from an old appendiceal abscess and ulcer of the bladder. The patient made a good recovery and was discharged in excellent condition.

Case A298707, E. S. L., a man aged 33, came to the clinic December 3, 1919, because of fistula between the bladder and the bowel. In 1911 the patient first noticed that he passed gas through the urethra following a strain playing tennis. At irregular intervals since he had passed pus, gas, fig seeds, and particles of food. Just before the first passage of gas the patient had had a severe attack of appendicitis. In 1914, he had an attack of pain in the right groin accompanied by swelling of the testicle, which was relieved by medication. A similar attack one year later necessitated drainage of the epididymis. The patient suffered almost continuously from trouble in his bladder during the 3 months before coming to the Clinic. A 24-hour specimen of urine, 1 050 cubic centimeter, had a specific gravity of 1 016, acid reaction, albumin 1, and pus cells 2. Succeeding urinalyses did not vary materially. The blood test revealed hæmoglobin 77 per cent, erythrocytes 4,064,000, leucocytes 9,600. The Wassermann test on the blood was negative. An X-ray of the kidneys, ureters, and bladder was negative; an X-ray of the colon showed a fistula between the cæcum and the bladder. The cystoscopic examination showed a vesico-intestinal fistula.

At operation, December 27, 1919, the abdomen was opened through a right rectus incision and the appendix was found to be adherent to the right posterior wall of the bladder. The appendix and the fistulous tract into the bladder were removed and the opening in the bladder was closed with plain catgut. The abdomen was closed without drainage.

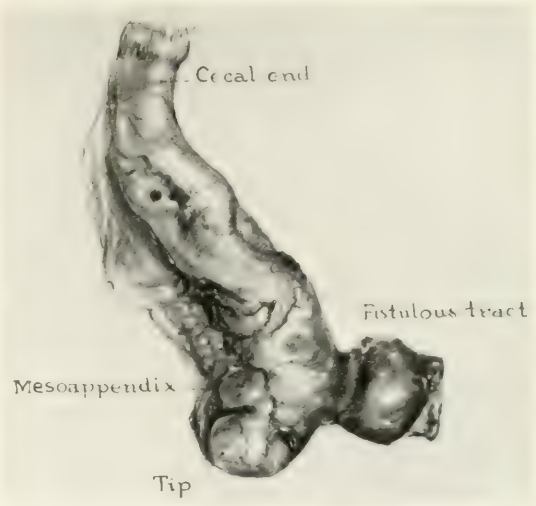

Fig. 2. Appendix and fistulous tract which communicated with the bladder.

The pathologic report was: chronic catarrhal appendicitis; a fistulous tract connected with the bladder; the center of the lumen 12 millimeters from the tip of the appendix.

The patient made an uneventful convalescence and was dismissed two weeks after operation (Figs. 1 and 2).

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THE COMBINATION OF RADIUM AND THE X-RAY IN CERTAIN TYPES OF CARCINOMA OF THE BREAST

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SINCE Despaignes first proposed the use of the X-ray in the treatment of cancer in 1896, the method has steadily increased in favor, and, with improved equipment and technique, its field has been very much enlarged. Many of the early X-ray workers reported results that are little short of marvelous, in view of our present knowledge of their technique and equipment. Since 1900 the reports of X-ray effects on breast cancer have become more and more voluminous until it is now a well established fact that this agent occupies a place in the treatment of every case of carcinoma of the breast.

Pfahler (1) has for a long period advocated its use not only in the inoperable and recurrent cases but in all postoperative cases. Dachtler (2) has noted that with its use skin recurrences have been practically eliminated, in his experience. Ochsner and Percy (3) have observed this effect on superficial involvement in mentioning the benefit conferred in carcinoma *en cuirasse*. Boggs (4) and Bythell and Barclay (5) reported good results from both, prophylactic radiation and treatment of recurrences, as well as in primary inoperable cases. Holding (6) attempted to render certain cases operable by using the X-ray first, and reported good results. Morton (7) treated the open wound at the time of the surgical removal of the breast in order to obtain as direct an application as possible. Kienboch (8) and von Angerer (9) have noted that the malignant cell is rendered less active and Reichold (10) has reported an inoperable case, operated on a year after treatment was begun, and no cancer cells found upon microscopic examination. Our own experience, and that of many others, have confirmed this wide range of benefit to be obtained by the use of X-ray in breast cancer.

Soon after X-ray began to attract attention, radium was also found to have a marked effect on carcinoma of the breast, but the scarcity of the metal prevented its widespread use and the reports have been less numerous. There seems also to have been little effort made to combine the use of the two agents.

The Radium Institute of Great Britain (11) has reported good palliative results in recurrent cases and has noted especially that pleural involvement could be benefited for a time by using heavily filtered radium after a primary paracentesis. Barcat (12) has reported that best results should be expected in circumscribed lesions, and, in his series of breast cases, mentioned seven operable cases treated by surface applications of radium with apparent disappearance of the growths in all.

At the Manchester and District Radium Institute, Burrows (13), in 1917, reported some encouraging results. Of 57 cases of all stages treated 5 were well at the end of the year, 22 were definitely improved, 5 died, and 14 had been under treatment for too short a time to report. In 1914 Aikins (14) reported good palliative results from the local application of radium in inoperable recurrences. Kelly (15) has also endorsed its use in recurrent cases. Burnam (16) advises it as a postoperative measure, and in recurrences as long as they remain regional, but states that where there is lung or mediastinal involvement it is contra-indicated.

Dieffenbach (17) has reported a case which refused operation and was treated with radium, well 6 years after, and an inoperable case quiescent 7 years after the first treatment. Duane and Greenough (18) noted some local improvement from surface applications but no effect on the internal course of the disease and concluded that for recurrent breast cancer, massive doses of X-ray give better results. In reporting the work of the Radium Institute of London for 1917, Pinch (19) mentioned 63 cases of all stages of breast

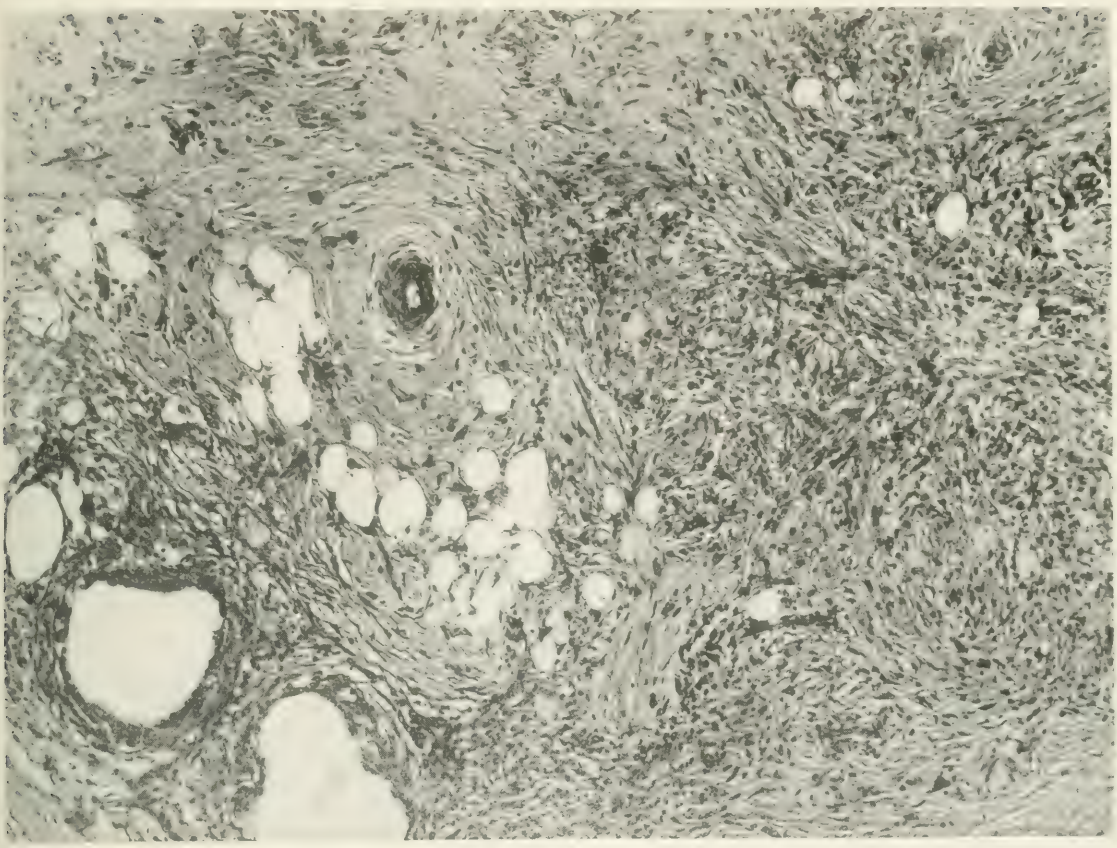

Fig. 1. From mammary cancer, of large opaque cell type, removed 7 weeks after treatment by buried radium emanation. Hydropic degeneration, necrosis, shrinkage, and nuclear pyknosis of tumor cells. Fibrosis and exudation of lymphocytes and plasma cells.

cancer treated. One case was apparently cured, 39 were improved, 7 unimproved, 2 abandoned treatment, 8 died during the year, 4 cases were for prophylactic radiation, and 2 were only recently under treatment. In the report on *radiumtherapy in cancer at the Memorial Hospital* for 1915-16 Janeway (20) reported an advanced inoperable case treated first in October, 1915, and clinically free from disease at the time of making the report. This patient is still well. Lowenthal (21) mentions the pronounced effects of radium on localized nodules and skin metastases and quotes the excellent results of Czerny and Wickman and Degrais in primary inoperable and recurrent cases. He also notes a recurrent case with axillary nodes treated by Finzi and Schaed in which, death having accidentally supervened, all evidence of new-growth was found to have disappeared. Ransohoff (22) has also reported an interesting case, inoperable because of myocarditis and nephritis, treated with radium. The tumor was of the scirrhus type, half the size of the adult fist, occupying the upper outer quadrant of the breast and with no axillary involvement. Seven months after treatment was begun no traces of the tumor were to be found. In a personal communication the writer was informed that this case remained well for 2 years and was then lost track of.

While the preponderance of literature on the treatment of breast cancer by physical agents is on the X-ray side, because of its accessibility, it is, however, evident that radium also exerts a marked influence on this

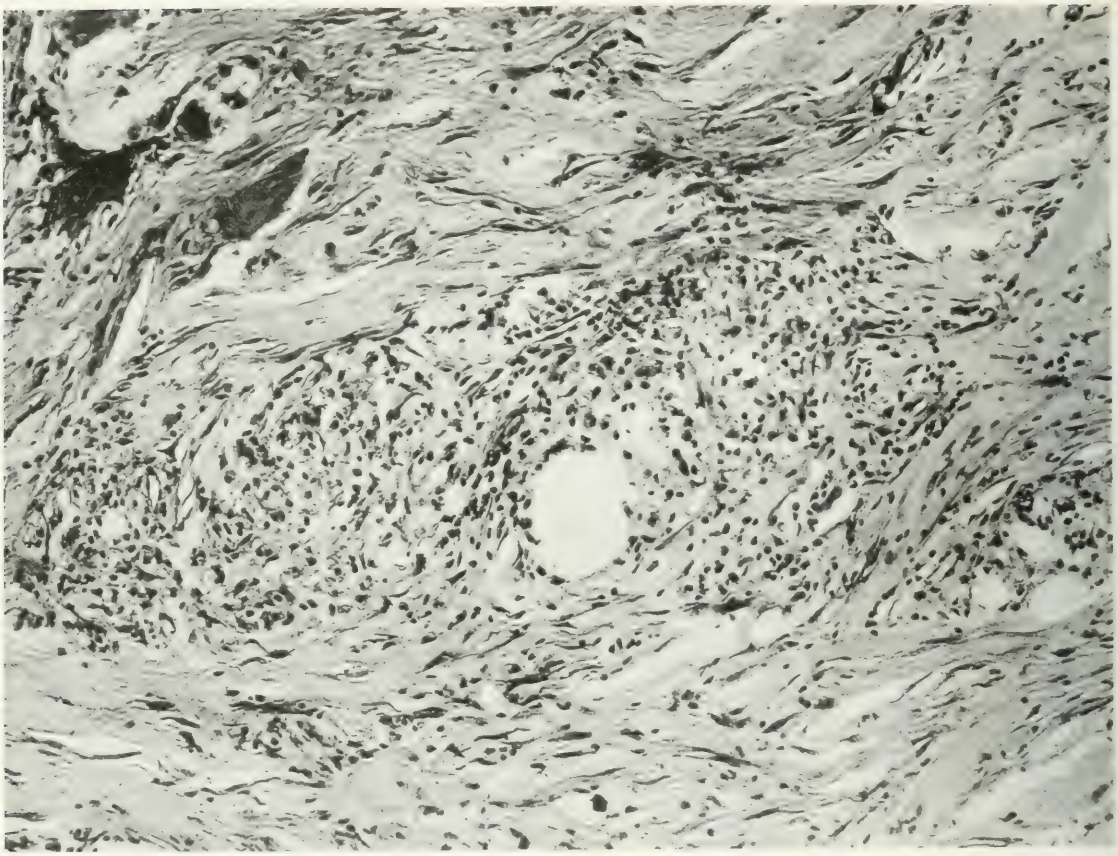

Fig. 2. From tumor removed 7 weeks after treatment by buried radium emanation. The central cellular area represents proliferation of fat cells. Above are foreign body giant cells in dense fibrous tissue. No tumor cells are recognizable.

growth. It is striking to note in the literature that, for the most part, the workers in the two fields have kept distinctly apart and only more recently do we find any effort made to combine the two agents. Another observation of the earlier radium workers is worthy of note. Practically all of them have reported more favorably on those cases where the lesion was localized and accessible. In other words they appreciated the fact that the accuracy of, and to a large degree the intimacy of, application was essential to a good end-result. A few have attempted to obtain still more intimate approximation of the radium by burying it in the tumor tissue, in various containers, which are afterward removed. In this work, it will be noted that the less filtration afforded by the container the better the result.

In 1903 Caspari (23) injected insoluble radioactive salts into a bulky carcinoma *en cuirasse* and demonstrated the destructive effect of the radium on the cancer cells: the entire mass was softened and liquefied. While this was not a practical method, still it showed the effect of unfiltered radium on the neoplastic cells.

Knox (24), in 1915, reported the burying of filtered radium tubes in the rapidly growing columnar cell type and in atrophic scirrhus carcinoma. In the latter he was able to cause complete regressions when necrosis was produced. He also advised the use of the X-ray with radium. Dawson Turner (25) reported a case of medullary carcinoma, recurrent over the sternum treated by burying two 5 milligram tubes screened by glass and aluminum

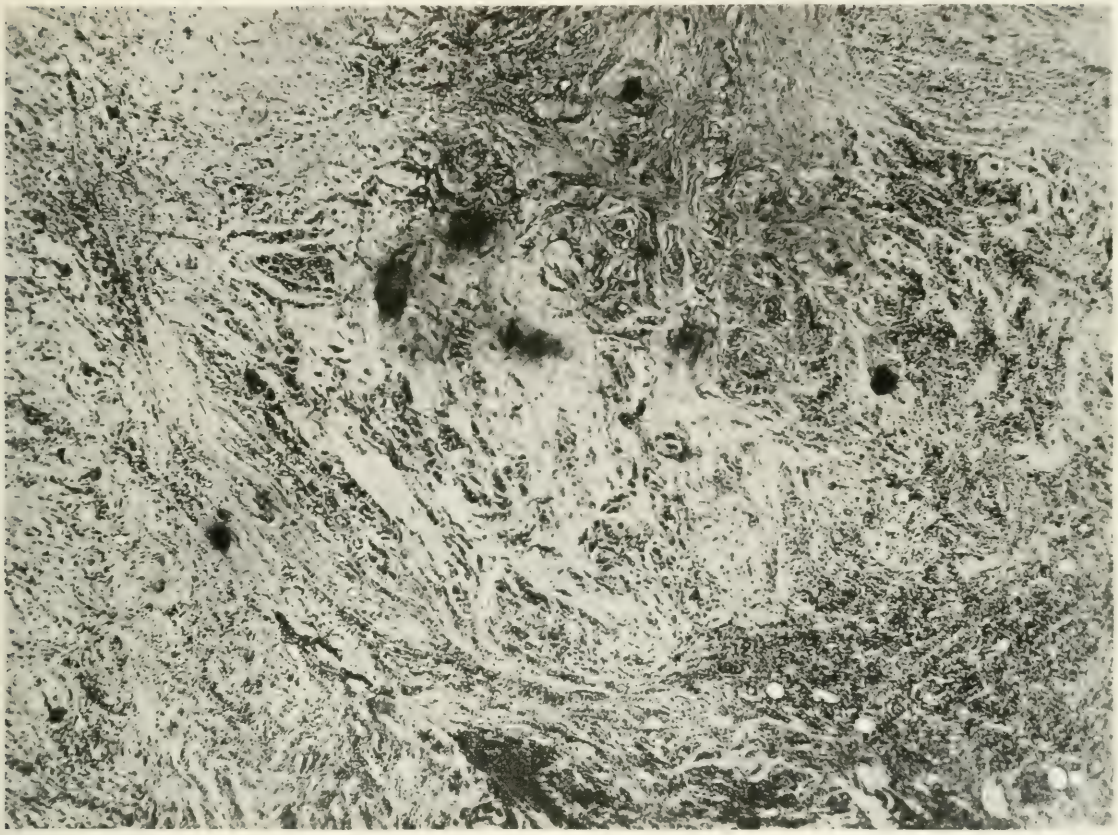

Fig. 3. From mammary cancer removed 6½ months after treatment by buried radium emanation. Showing cicatrization, calcification, and exudate of lymphocytes and plasma cells. Many tumor cells have been destroyed and others are shrunken, compressed, and exhibit pyknotic nuclei.

in the mass for 7 and 12 days respectively—a total dose of 2,400 milligram hours. In addition, silver filtered radium was used over the surface for a total dose of 800 milligram hours. The tumor disappeared in 6 weeks and the patient was still well at the time of his report, several months later. In the report of the Manchester and District Radium Institute for 1916 (26), an inoperable case is mentioned, treated much the same as Dawson Turner's case. For the internal radiation five tubes filtered by 0.3 millimeter of platinum, and containing 20 millicuries each, were used for 24 hours, and repeated in 2 months with 4 tubes. In addition, surface plates were used, and the patient was reported clinically free from disease at the end of the year. Morton (27) reported a primary case, in which operation had been refused, treated by burying a single tube in its center for several hours. A severe necrosis resulted and a simple excision of the breast was done because of the ulceration. Examination showed some cancer cells still present but at the time of his report, 7 years later, the patient was still well.

While these attempts to obtain more intimate applications of the radium were founded on a sound theoretical basis, still they were open to criticism from a practical standpoint. The tubes used were necessarily large and to get them in place necessitated an incision which actually amounted to an incomplete operation. Apart from the danger of metastases this opened up an avenue of infection into the tumor tissue. In no instance

were sufficient tubes used to produce a uniform radiation through the tumor. A zone of necrosis was produced around the tubes, but unless this was very severe the periphery of the neoplasm was not radiated sufficiently, and it is well known that the most active cells are located in this area. In this Bradshaw Lecture on Cancer, Pearce Gould (28) quoted Bashford's work as proving that only peripheral cells of a graft lived. Thus it was only possible to reach the periphery at great expense to the tissues in the center of the mass.

Altogether, a review of the literature creates the impression that, in general, the worker confining his efforts to X-ray alone tends to minimize other physical agents, while the radium therapeutist has attempted to cover too large a field with the amount of the element at his disposal. The X-ray has the advantage of being obtainable in unlimited amount at comparatively small cost. Radium, on the other hand, is both scarce and expensive, and must, therefore, be conserved as much as possible for those cases in which the greatest benefit can be produced. It has the advantage of being a more powerful agent and can be applied more accurately and in more inaccessible locations, in fact, can be applied in locations where the X-ray reaches only in much diminished quantity.

During the past 2 years at the Memorial Hospital we have made a consistent effort to combine these two agents in those cases of breast cancer where it was felt the peculiar features of each agent were best adapted to care for certain parts of the growth. While I believe that the use of radium over localized recurrent nodules, together with the X-ray over the regional areas, has been a distinct advantage, still, it is not in these cases that the combination has been of most value. In all localized bulky tumors, whether they are recurrences, lymphatic metastases, or primary inoperable growths, we have been able to embed radium emanation in the substance of the tumor in such a manner as to give a uniform, diffuse radiation throughout, especially in the deeper portion of the mass where the X-ray effect is least. Fine glass capillary tubes, approximately 3 by 0.5 millimeters in size, containing radium emanation, are prepared in the physical laboratory for this purpose. Each tube contains from 1 to 3 millicuries of emanation although a maximum of 2 millicuries is best. Under local anæsthesia, and observing all precautions of surgical technique, these tubes can then be inserted through fine trocar needles throughout the substance of the tumor in such number and strength as to give a uniform effect without gross necrosis of tissue. No open wound is left as an avenue of infection, since the trocar needles are no larger than a medium sized record syringe needle. The tubes are left in place permanently and become encapsulated by fibrous tissue. The emanation decreases in strength at a definite rate, and it is possible to calculate the exact total dosage to be derived from a single tube by knowing its strength at the time of insertion.

The prolonged radiation thus obtained, extending over a period of several weeks, appears to be more beneficial than the same total dosage delivered in a few hours. There is no filtration other than that afforded by the thin glass and consequently practically all of the beta radiation is utilized. This is probably the most valuable feature of applying radium interstitially.

The tubes should always be inserted through intact skin and care taken to avoid necrotic infected areas of tumor tissue, else infection will only be spread to the deeper parts of the neoplasm and aid in the breaking-down process. It will be noted that the emanation embedded in this manner takes care of the deeper part of the neoplasm and in no way interferes with the application of X-ray over the surface.

Unless there is some very definite reason to the contrary, every patient is then given X-ray in massive doses over the entire local and regional surface. The skin over the breast region and all regional lymphatic areas is divided into multiple portals and massive doses of heavily filtered X-ray delivered at cross-fire. In other words, the X-ray treatment is made as thorough as though no radium were available. Increased intensity of skin reaction is avoided by allowing for the different time factor in the oncoming

reaction of X-ray and radium, and varying the X-ray exposure over the local area to meet this properly.

A few cases are cited below as examples of types lending themselves best to treatment in this manner by a combination of physical agents.

Case 1. F. M., Hospital No. 25339, age 55, admitted to hospital service, April 1, 1918. Diagnosis: recurrent carcinoma of right breast.

The right breast had been amputated in July, 1916, for carcinoma, and in October, 1917, the patient noted a slight "swelling" near the sternum on the right side, which steadily increased in size. At the time the patient entered the hospital she was in good general condition. Centered over the second right intercostal space, just lateral to the sternum, was a hemispherical tumor 10 by 15 centimeters in size and elevated 4 centimeters. The mass was hard and firmly fixed to the ribs. The skin was fixed over it. No palpable regional nodes.

Treatment on April 2, 1918: radium emanation in 8 tubes, a total 32 millicuries, was embedded in the tumor mass through fine trocar needles. The radium "pack" filtered by 2 millimeters lead and ½ millimeter silver was placed over the mass at a distance of 10 centimeters for a total dosage of 18,200 millicurie hours. On July 3, 1918, radium emanation in 5 tubes, a total of 18.5 millicuries, was embedded in the tumor as before. On February 19, 1919, radium emanation in 3 tubes, a total of 12.6 millicuries, was embedded in the tumor, as before. Up to present time 3 complete cycles of massive X-ray treatment had been given over the anterior chest and all the regional lymphatic areas. For past 6 months there has been no visible or palpable evidence of disease. The skin is in good condition; the general condition of the patient is excellent.

Case 2. Mrs. J. B., age 57, admitted to hospital service July 27, 1918. Diagnosis: recurrent carcinoma of the left breast.

In February, 1917, a mass was noted in the outer quadrant of the left breast. A radical breast amputation was done March 7, 1917. In May, 1918, a mass was noted in the left pectoral region above the scar of previous operation. This mass has rapidly increased in size and others have appeared. On admission to the hospital, the patient was in fair general condition but was just beginning to lose weight and showed a moderate anæmia. Beneath and infiltrating the remains of the pectoral fold there was a hard fixed mass 3½ centimeters in diameter. At the apex of the axilla another mass about 2½ centimeters in diameter was palpable and along the scar of the previous operation, there were three other smaller nodules each about 1½ centimeters in diameter, all fixed to deeper structures but not adherent to the skin. The arm was moderately swollen and painful. No palpable supraclavicular nodes were present.

Treatment. On July 24, 1918, radium emanation in 18 tubes, a total of 45 millicuries, was embedded through fine trocar needles, in the masses described. Nine complete cycles of X-ray were given in massive dosage at cross-fire through multiple portals of entry and over the anterior and posterior chest and all regional and lymphatic areas.

At present the general condition of the patient is excellent. She has gained considerable weight. For a time she had much pain in the lower back, which was thought to be due to metastatic involvement of the spine, but the X-ray examination failed to substantiate involvement and the pain has since cleared up. The local recurrent masses have entirely disappeared, and the skin is in good condition, and there is now no visible or palpable evidence of disease.

Case 3. B. L., Hospital No. 26718, age 68, admitted to hospital service July 30, 1919. Diagnosis: recurrent carcinoma of left breast. The left breast was removed for carcinoma 17 years ago. Three years ago a local recurrence was removed at the inner end of the scar and at this time it was found necessary to remove a portion of rib. For the past 5 months another recurrence increasing in size has been noted in the same location. Pain has also increased.

On admission to hospital, examination showed an elderly woman in poor general condition, who appeared considerably older than age given. The appetite was poor, and she was losing weight. Over fifth, sixth, and seventh left costal cartilages there was a hard, discoid swelling 4 by 7 centimeters, raised 2½ centimeters, and firmly fixed to ribs. The skin over it was adherent and broken down over one small area 1½ centimeters in diameter. X-ray examination showed a localized pleural involvement on the left side anteriorly. No palpable regional nodes were present. The patient had severe pain at site of mass and radiating around to the back between the scapulæ. She cannot lie down because of pain and embarrassment to breathing.

Treatment. On July 30, 1919, a radium pack, filtered by 2 centimeters lead and ½ centimeter silver, was applied at a distance of 6 centimeters over the recurrent mass for total dosage of 12,312 millicurie hours. On July 31, 1919, 12 emanation tubes, a total of 14 millicuries, were embedded in the recurrent mass through fine trocar needles. Two cycles of X-ray treatment were given over the anterior chest and all regional lymphatic areas.

At present there is no visible or palpable evidence of disease externally. The skin is entirely healed and in good condition. The condition of the pleura has definitely improved so that the pain has ceased and patient is able to sleep all night comfortably and in a natural position. The general condition is much better. The patient has gained weight and strength and is able to go out for daily walks.

Case 4. E. O., Hospital No. 25574, age 39, admitted June 18, 1918. Diagnosis: recurrent carcinoma of the left breast.

The patient noted a mass in the left breast in January, 1918, and 2 weeks later a radical breast amputation was done. During the latter part of March the patient noted four or five small lumps at site of breast removed and in axilla. These have rapidly increased in size.

On admission the patient was in good general condition with no loss of weight. Beneath the lower end of the scar of operation there was a hard hemispherical tumor mass 8 centimeters in diameter and raised 2½ centimeters. The mass was fixed to the ribs and the skin was adherent over it. Along the scar all the way up to the axilla were 5 separate subcutaneous nodules, similar to the other one but smaller, ranging in size from 1 to 2½ centimeters in diameter. The patient has severe pain radiating down the arm and about the shoulder girdle, but no swelling of arm.

Treatment. On June 18, 1918, over each of the five masses a dosage was given of 705 millicurie hours filtered by ½ millimeter silver and 2 millimeters lead at a distance of 1 centimeter; on August 5, 1918, over the left pectoral region a "boxpack" of emanation filtered by ½ millimeter silver and 2 millimeters lead at a distance of 6 centimeters, giving a total dosage of 12,420 millicurie hours. On November 5, 1918, emanation tubes containing a total of 14 millicuries were embedded, through trocar needles, in the large mass previously described. On March 3, 1920, 7 emanation tubes, containing a total of 9 millicuries, were embedded as before in the remains of the mass just described. Nine complete cycles of X-ray treatment were given at cross-fire over anterior and posterior chest as well as over all regional lymphatic areas.

At present the patient's general condition is fair. No new nodules developed after radiation was begun. The large mass described is now represented by a small nodular area probably largely cicatricial in character. Other masses have entirely disappeared. One area of skin 2 centimeters in diameter has broken down from the effect of X-ray.

Case 5. A. H., Hospital No. 26314, age 52, admitted to hospital March 19, 1919. Diagnosis: recurrent carcinoma of the right breast.

The right breast was removed for carcinoma 3 years ago. During the past 10 months cutaneous and subcutaneous nodules have gradually appeared locally.

On admission the patient was in good general health. At mid-point of scar from breast amputation was an area of skin 5 by 8 centimeters involved by a reddened, partially ulcerated and crusted mass with numerous hard neoplastic nodules over its surface, and all fixed to the underlying ribs. No palpable regional nodes were present. X-ray examination of the chest was negative.

Treatment. On February 21, 1919, a radium pack filtered by 2 millimeters of lead and ½ millimeter of silver was applied over the area described at a distance of 3 centimeters, giving a total dosage of 4,234 millicurie hours. On February 20, 1919, massive X-ray dosage was begun over the regional glandular areas. In all, 5 cycles of treatment were administered.

Recently two new nodules have appeared at the inner side and are being treated by X-ray. All nodules described originally have disappeared and are represented by small areas of dense cicatricial tissue. General condition excellent.

Case 6. A. P., age 45, admitted to hospital April 16, 1919. Diagnosis: metastatic carcinoma of breast.

The right breast was removed for carcinoma, 4 years ago. A local recurrence appeared about a year ago and was promptly removed. About this time several nodules appeared over the scalp and steadily increased in size. On admission eight nodules, ranging in size from 0.5 to 1.5 centimeters in diameter were palpable beneath the skin of the scalp. The nodules were hard and fixed to the skin but were slightly movable with the exception of one low down toward the back of the neck which was firmly fixed to the underlying muscle. The breast region presented no evidence of recurrence and there were no palpable regional glands.

Treatment. On April 16, 1919, five tubes of radium emanation, each of 36 millicuries strength, and filtered by 0.2 millimeter of aluminum were applied over five different nodules at a distance of 5 millimeters from the skin surface and were kept in place for 1 hour and 5 minutes. On April 23, 1919, three tubes of radium emanation containing 50 millicuries each filtered by 0.5 millimeter silver were applied over the other three nodules for 1½ hours. On March 10, 1920, one emanation tube containing 2.1 millicuries was embedded through a fine trocar needle in the remains of the nodule, low down toward the back of the neck.

Seven of the nodules disappeared entirely after localized surface application of radium. The larger and deeper one which did not disappear entirely at first is now rapidly regressing since the emanation tube was buried in it. The patient's general condition is good. No new nodules have appeared.

Case 7. M. E., Hospital No. 26315, age 56, admitted to hospital March 19, 1919. Diagnosis: recurrent carcinoma of right breast.

The right breast was removed by radical amputation about a year ago. For past 3 months enlarged nodes have been noted above right clavicle and more recently the arm has begun to swell.

On admission the patient was in good general condition. The local breast region was free from recurrence. Nodes in the right axilla were enlarged up to 1½ centimeters in diameter. There was a mass of nodes above the clavicle up to 1 centimeter in diameter. The arm was swollen. Radiographic examination of chest showed a few small, fibrous nodules of questionable significance at the right hilus. The left side was free from palpable evidence of disease.

Treatment. On March 20, 1919, 6 tubes of unfiltered emanation, total of 15 millicuries, were em-

bedded through fine trocar needles in the right axilla and supraclavicular space. Massive roentgen therapy was begun over all regional glandular areas as well as over local mammary region and continued until by June 13, 1919, 3 complete cycles had been administered. The patient then went to live at some distance from New York.

At present the swelling of arm has disappeared. In the axilla nodes the size of peas were palpable. Supraclavicular nodes were not palpable. The general condition of patient is good. A distant bony metastasis developed sometime after leaving the hospital and this is reported improving under X-ray treatment.

CASE 8. L. M. M., Hospital No. 26336, age 49, admitted to hospital March 29, 1919. Diagnosis: recurrent carcinoma of right breast.

About 6 months previous to admission here the patient had noted a mass in the right breast, following which a radical breast amputation was done. Nothing further was noted until 1 month ago when several small nodules appeared about the scar.

On admission the patient was in poor general condition. She complained of severe pain about breast region, right shoulder girdle, and extending up to the back of the head. The appetite was poor and she was losing weight. Above the scar of recent operation the skin over an area approximately 10 by 16 centimeters was studded with multiple cutaneous and subcutaneous nodules, many of which had become confluent and some of which had broken down superficially and were covered by crusts. Several small, hard nodes were palpable in the supraclavicular space and in the lower cervical region.

Treatment. On March 29, 1919, a radium pack filtered by 2 millimeters lead and ½ millimeter silver was placed at a distance of 6 centimeters over upper breast and lower pectoral region for a total dosage of 10,020 millicurie hours. A similar pack was applied over the upper pectoral, infraclavicular and supraclavicular regions for a total dosage of 10,020 millicurie hours. On February 28, 1920, a dosage of 10,000 millicurie hours at 6 centimeters distance was applied over the lower chest anteriorly. Four complete cycles of X-ray treatment, through multiple portals of entry, at cross-fire were given over the right chest and all regional nodes.

At present there is no visible or palpable evidence of disease externally. The patient had been able to resume her work as saleslady until early in February when pain in the lower right chest became annoying. X-ray examination suggested pleural involvement and the pack was used over it as noted. The patient has now improved materially, pain has decreased, and the general condition is good. X-ray treatment is being resumed with more vigor.

CASE 9. S. W., Hospital No. 25547, age 70, admitted to hospital June 10, 1918. Diagnosis: primary carcinoma of left breast.

A small lump was noted in breast in April, 1916. This increased in size, became painful locally and later was accompanied by pain down left arm. On admission the patient was in poor general condition. In the upper outer quadrant of the left breast there was a very hard mass 4 centimeters in diameter, fixed in the breast tissue and movable with it as a whole. The skin over it was fixed and depressed. One node, 1.5 centimeters in diameter, was palpable beneath the lower portion of the pectoral fold; none was palpable elsewhere.

Treatment. On June 12, 1918, the area over the breast mass was treated with a dental modelling compound applicator, 16 centimeters square, in which were embedded 10 tubes of radium emanation filtered by ½ millimeter of silver and placed 5 millimeters from the skin surface. A dosage of 63 millicurie hours per square centimeter was given, a total of 1 005 millicurie hours. On November 26, 1918: radium emanation in 3 tubes, a total of 10.6 millicuries was embedded in the tumor through fine trocar needles. On March 5, 1919, 7 tubes, a total 15 millicuries, were embedded in the tumor as before. On August 28, 1919, 5 tubes, a total of 7 millicuries, were embedded beneath the pectoral fold. Due to the advanced age of the patient and the inability to get about readily, X-ray treatment was not given.

At present the general condition of the patient is practically unchanged. The breast mass is replaced by what appears to be a small amount of cicatricial tissue. The node below the pectoral fold, noted originally, is barely palpable and no new nodes have appeared.

CASE 10. L. A. S., age 49, admitted to hospital May 9, 1919. Diagnosis: primary carcinoma of right breast.

About 2 years ago the patient was injured in the breast by a blow from a swinging door and soon after noted a small hard mass in the upper outer quadrant. This mass remained unchanged until 8 months ago when it began rather rapidly to increase in size and more recently became painful. On admission the patient was in good general condition and had not lost weight. In the upper and outer quadrant of the right breast, there was a hard infiltrating mass 2.5 by 3.5 centimeters in size, over which the skin was moderately fixed. The mass was fixed in the breast but was movable as a whole over the chest wall. Beneath the pectoral fold, there were several small palpable nodes and one of them toward the axilla was 1.5 centimeters in diameter. No nodes were palpable in the apex of the axilla. Radical removal was advised but was refused by both the patient and her husband, both of whom insisted upon treatment with radium. After several consultations, and with patient fully advised as to the uncertainty of the result, radium and X-ray treatment was decided upon.

Treatment. A preliminary complete cycle of X-ray in massive doses delivered at cross-fire through multiple portals of entry was given over the breast and all regional lymphatic areas. On June 17, 1919, radium emanation in 6 tubes, a total of 16 millicuries, was embedded in the primary breast tumor through

fine trocar needles. Another group of 6 tubes containing a total of 6 millicuries was embedded in the same manner beneath the pectoral fold and upward toward the apex of the axilla. Following this, three complete cycles of X-ray at intervals of about 6 weeks were given in the same manner as the preliminary X-ray cycle. At present, the patient is in excellent general health. The primary tumor is replaced by a small area of dense cicatricial tissue which we interpret as fibrosis resulting from the radium embedded in it. There are no palpable regional nodes.

Case 11. A. W., Hospital No. 25157, age 43, admitted to hospital January 26, 1918. Diagnosis: metastatic carcinoma of right breast.

The right breast was removed in 1914 for carcinoma and a few months after this a non-malignant (?) growth removed from the left breast. In August, 1916, the patient began having "neuralgic" pains in the lower extremities, and in July, 1917, several subcutaneous nodules appeared about the right breast region and over the sternum. These increased in size and new ones appeared. Pain in the lower extremities increased and became general over the body. On admission the patient was in poor general condition, losing weight. She walked with difficulty and was anæmic. Hæmoglobin, 49 per cent; red blood cells, 2,920,000; white blood cells, 3,600. The pulse was rapid, 110-120 and temperature 98° to 100°.

Over the right breast and sternum and the abdomen, there were numerous cutaneous and subcutaneous nodules, ranging in size from ¼ to 2 centimeters in diameter. These were very hard, but movable with the skin. Numerous small, hard, movable nodes were palpable on both sides of the neck. Pain about the left knee led to X-ray examination which showed a localized area of rarefaction 3 centimeters in length in the fibula just below its head, and further examination of the entire skeleton revealed multiple areas of absorption through the bones, with a diffuse osteoporosis in practically all, thus indicating a generalized carcinomatosis of the entire bony skeleton.

Treatment. During the course of treatment about 50 different nodules have been treated by localized surface applications of radium, average doses being about 500 millicurie hours, filtered by 2 millimeters lead and ½ millimeter silver at a distance of 2 centimeters from the surface. In addition the patient has had 2 intravenous injections of active deposit of radium dissolved in normal saline, as follows: July 7, 1919, 129.4 millicuries in 5 cubic centimeters of saline; August 7, 1919, 195.3 millicuries in 8 cubic centimeters of saline.

X-ray radiation has been used over all of the bony skeleton in massive dosage so that the patient has received five complete cycles of radiation in this manner.

A note made November 12, 1919, states that patient's general condition is distinctly better than when she first applied for treatment. There is no rise in temperature. The pulse remains rapid but is well controlled by medication. The patient is able to be up most of the day at present and at times she has been able to attend comfortably to household duties. She has gained weight, all pain has disappeared, the hæmoglobin is 60, red blood cells 3,500,000, white blood cells 3,000.

All of the nodules treated by local surface radiation showed a marked susceptibility in that very few required more than one application to cause a complete disappearance. X-ray examination of the bony skeleton at present shows practically no increase in the destructive process while in several places there is definite evidence of repair. There has been no injury to the skin produced by this radiation.

The patient is now spending the winter in the South and reports that she is in better health than she has been for over 2½ years. On December 2, 1919, the patient died suddenly after an acute attack lasting a few hours, apparently cardiac failure. The pulse became much increased in rate and thready in character, cyanosis was marked, breathing was rapid and labored. No autopsy was obtained. As nearly as could be ascertained the carcinomatous process had no direct bearing on the cause of death.

Case 12. M. F., Hospital No. 26446, age 56, admitted to hospital May 6, 1919. Diagnosis: primary carcinoma of left breast.

One year ago the patient had noted a mass in the breast and a nodule in the axilla. Two months before admission, she had noted nipple retraction and pain in the axilla together with pain and swelling in the arm.

On admission the patient was in fair general condition, not losing weight. There was a mass in the lower outer quadrant of the breast 12 centimeters in diameter. The nipple was retracted and the skin fixed to the tumor in the breast with numerous subcutaneous neoplastic nodules over this area as well. The lymph nodes were enlarged in both axillæ and both supraclavicular spaces. The left arm was greater in circumference at the mid-humeral region than the right. X-ray of the chest was negative.

Treatment. On May 20, 1919, unfiltered radium emanation tubes were inserted through fine trocar needles as follows: 8 tubes, 27 millicuries, into left breast tumor; 3 tubes, 9.9 millicuries, into left axilla; 3 tubes, 9.9 millicuries, into left supraclavicular region. On July 9, 1919, heavily filtered massive X-ray therapy was begun over the breast and regional glands of both sides giving in all 3 cycles of treatment, up to December 1, 1919. At this time the patient was in good general condition. The arm swelling had entirely disappeared. The breast mass was markedly decreased and palpable nodes had decreased about two-thirds in size.

On January 19, 1920, the patient died in hospital of an influenzal pneumonia. At autopsy there were numerous pelvic metastases but the local breast condition was extremely interesting. Dr. Ewing reported as follows:

"The breast is of about normal size, rather flat, slightly restricted in motion, moderately nodular, with one ill-defined tumor area. The nipple is slightly restricted in mobility, not fixed, slightly depressed. There are three hard, fixed nodules along the pectoral fold, each the size of a marble.

"On section the breast shows a single well defined cicatricial fibrous area less than 2 centimeters wide, in which are the silvery streaks of carcinoma. No outlying nodules of tumor tissue could be found. The remaining breast tissue is scanty and slightly fibrous. Just above the outer upper border of the breast is a cicatricial nodule 1 centimeter wide, giving the texture of a fibrocarcinoma. Three other cicatricial areas of the same size and character as the first appear along the pectoral border. Nothing could be felt in the supraclavicular space, which was not dissected out. At the apex of the axilla the vessels are encased in a mass of tumor tissue 1½ centimeters wide. From this point the tumor tissue extends along the deep fascia beneath the pectoral muscle and over the intercostal muscles between the first three ribs. The cicatricial process has greatly reduced the size of the mammary tumor and shortened the distance between the breast tumor and the axillary growths.

"The structure of the tumor is everywhere that of diffuse infiltrating carcinoma without any trace of alveolar arrangement of cells. In the abdominal areas the structure resembles lymphosarcoma. In the thoracic areas there is much fibrosis. In the breast and axillary lymphatics there is extensive degeneration and necrosis of tumor cells and fibrous tissue. About the radium tubes there are areas of complete necrosis about 1 centimeter wide and an equal additional area of severe degeneration."

The foregoing case reports are given to illustrate types suitable for the combined action of physical agents and should in no way be interpreted as a complete report of the work done along these lines at the hospital.

The time limit in these cases is indeed short and, of course, nothing can be claimed for them except the results to date. We do feel, however, that the results represent an advance in the treatment of such advanced stages of the disease.

In all, we have treated 78 cases by this combination of radium and X-ray during the past two and a half years. Of this number, 7 patients have shown complete regressions of the treated areas and up to the present time have remained clinically free from disease for periods ranging from 3 months to more than 2 years.

Twenty-one cases have shown partial regressions which are still progressing, but not as yet clinically free. No case has been included in this group treated under 5 months and 4 cases have been treated for 2 years.

Many cases have received temporary benefit only. In this group we have 24 cases where local improvement continued for periods ranging from 2 months to 2 years and was followed by an aggravation of symptoms from distant metastases. Of these, 19 cases have died. In no instance was there a lighting up of the local condition at the terminal period. The striking feature of this series of deaths is the preponderance of extensive pleural involvements. In 11 cases the first clinical evidence of a terminal stage was the pleural involvement with hydrothorax and dyspnœa which terminated fatally in a short period, usually 2 to 4 months. Three cases showed extensive visceral involvement and 5 cases generalized bony metastasis, principally in the spine.

We have been unable to follow 9 cases, and therefore must assume that they have ended unfavorably, although in 4 instances the progress, as far as we were able to follow, was favorable. One case was clinically free from disease a year after treatment and another much improved at the same interval, while the other two progressed favorably for several months, until lost sight of.

In 10 cases there was no improvement from treatment. In all of these cases, the disease was not only far advanced locally but was disseminated widely throughout the body. There comes a time when it is even too late to use physical agents, and the acceptance of these cases for treatment was undoubtedly an error.

During the past 4 months 7 cases have been treated and while the initial response to treatment has been favorable in each instance, still the time interval is too short to warrant any conclusions.

Of the total number of cases thus treated, 78 in all, 57 have been recurrent or metastatic tumors while 21 were primary. With the exception of 1 case (Case 10), these were all inoperable tumors. Of the 20 remaining cases, 1 has been clinically free from disease for 6 months, 8 cases are still showing continued regressions, 5 improved temporarily,

2 have been lost sight of, 1 was unimproved, and 3 treated during the past 4 months, although progressing favorably, are too recent to report.

Cases presenting themselves for treatment by physical agents alone represent, usually, the worst types or stages of mammary cancer. The primary inoperable case is obviously well advanced while the recurrent case has usually had ample opportunity to extend beyond the bounds of localization. As a rule, therefore, the treatment must be looked upon as palliative and wherever a more permanent end-result is obtained it should be classed as a distinct victory.

Cases 5 and 8 illustrate a type of recurrence which might well be treated with X-ray alone, but the tendency for the recurrences to remain grouped and localized suggested the possibility of disposing of them more quickly and with greater assurance of permanent result, by using the more powerful agent at this point.

The subsequent course proved this to be correct: regressions were rapid, the patients were saved a large number of visits for X-ray treatment and the skin is now in better condition than it otherwise would have been. In the latter case the effect of radium on the pleural involvement is noteworthy. X-ray failed to control it, whereas a heavily filtered dose of radium over the local area gave prompt relief. This effect is most strikingly shown in the Case 3: The heavily filtered radium has relieved pleural symptoms for a period of over 9 months, to date, while the combined surface and interstitial radiation has caused a complete regression of the local recurrence. This patient is an elderly woman for whom it would have been a practical impossibility to come in for sufficient X-ray treatment to care for the entire course. She had as much X-ray as circumstances would permit but not enough to produce, alone, any marked regression. In Case 6, the recurrences were so located that extensive X-ray treatment would have produced epilation of hair over a considerable surface. Even with surface applications of radium the one nodule did not entirely disappear but with emanation buried in it, it has rapidly regressed. Case 11 was one in which a very large amount of radiation was necessary because of the widespread metastases. The local applications of radium in no way interfered with general X-ray treatment while they did produce rapid regressions of the nodules. The skin was thus saved considerably, and excessive radiation of such a large body surface was obviated. An added benefit was conferred by treating some of the more extensive but localized bone lesions in the same manner. The intravenous injections of active deposit of radium were given because the generalization of the disease suggested some hope for benefit by approach through the blood stream. It is impossible to say whether this was of benefit or not in one isolated case. Case 1 was an ideal one for the combination of X-ray and buried emanation. It is now 2 years since the emanation was used and the patient is not only free from the recurrence but her skin shows very little evidence of the previous treatment. This is not usually the case where such a bulky mass is treated by surface radiation alone. Case 7, while not of as long standing as Case 1, presented certain similar characteristics from the standpoint of selection of methods. The local result has been good and the distant bony metastasis was undoubtedly present but overlooked at the time of beginning treatment.

Cases 2, 4, and 9 have had in addition to the X-ray and buried emanation, localized surface applications of radium. Wherever this can be carried out, it undoubtedly adds very materially to the end-result. The direct surface application of radium over the localized mass, supplemented by a cross-fire of X-ray from all other angles, is preferable to X-ray alone over the surface. The practical side must here be considered, however, and it is only rarely possible to use larger quantities of heavily filtered radium for this purpose.

Case 9 was inoperable because of the age and general condition of the patient. The same factors prevented her coming for systematic X-ray treatment and consequently this was dispensed with. I believe she has derived the greatest amount of benefit with a minimum of discomfort from the treatment given. In none of these cases has it been

necessary to produce a breaking down of skin to obtain the results noted because the radiation has been distributed uniformly throughout the tumor. With surface radiation on the other hand, especially with X-ray alone, this frequently happens from the prolonged, repeated exposures, or from initial heavy doses. Sgalitzer (29) believes that X-ray treatment always gives best results when pushed to this point. In other words he advises a sacrifice of superficial healthy tissue in order to produce a greater effect on the deeper portions of the new-growth.

Case 10 represents a type of patient met by everyone seeing a large number of breast cancers. In deciding to treat her in the manner described we felt that we had discharged our responsibility by placing the facts squarely before her and her husband. I cannot agree with Newcomet (30) who states that radiation, when operation is refused, is questionable for, if the growth should be benign, radiation might cause it to become malignant. While the patient is now, after 12 months, free from clinical evidence of the disease the time is too short to form any opinion. It must be left until some future time to decide whether she has taken her life in her own hands or whether she has been wiser than we.

Case 12 is noted simply to show the remarkable effect of the combination of interstitial radiation with unfiltered radium emanation, and surface radiation with X-ray. It is only occasionally that we have such an opportunity to study the tissues microscopically in the case showing a favorable local course and the findings help us to visualize what is taking place in other cases at certain stages after treatment.

CONCLUSIONS

Our results from the use of X-ray and radium in breast cancer up to the present time seem to warrant the following conclusions:

1. The X-ray occupies a place in the treatment of every case of carcinoma of the breast.

2. In certain cases radium may be used to considerable advantage in combination with the X-ray.

3. The cases in which radium proves valuable in this combination are mainly:

a. Localized flat recurrences where surface applications of radium can be made directly over the lesion.

b. Bulky recurrences where radium emanation can be embedded directly into the tumor.

c. Axillary involvement which is always difficult to influence favorably with X-ray alone, where radium emanation can be embedded in the neoplasm or in axillary fat tissue so as to give a diffuse radiation of the axillary space from within.

d. Inoperable primary cases where embedded emanation can be utilized to radiate the tumor from within, as well as the axilla, and even supraclavicular space in the same way, if necessary.

e. Primary cases refusing operation where treatment may be carried out much in the same way as in the inoperable primary cases.

4. The combination of radium and X-ray may, in some instances, change an inoperable into an operable case.

Finally we wish to point out certain theoretical considerations which strongly encourage us to pursue the study of the treatment of mammary cancer by radium and X-ray. When one embeds radium emanation needles in a primary tumor and in invaded lymph nodes and follows with massive X-ray dosage through the skin, a powerful destructive effect is produced on the tumor tissue amounting to local necrosis, the lymphatics may reasonably be considered sealed, invisible vagrant cells are incarcerated or destroyed, and all this is accomplished without removing the natural barriers which exist against progressive carcinoma. In fact both types of radiation tend to increase the exudation of lymphocytes and plasma cells and the growth of connective tissue around the tumor, and these are the only natural agents of resistance to carcinoma that we know anything about. The treatment of mammary cancer by these physical agents is, therefore, based on sound theory since it intensifies the natural reaction of the tissues to carcinoma, while producing in addition a very strong destructive action on the tumor cells.

In view of these theoretical considerations and of our clinical results to date we feel that the scope of operability in mammary cancer should be reduced. Already the pendulum has swung far in this direction in other fields, notably in uterine carcinoma. Here the fallacy of operating on advanced growths has been generally recognized, surgery has been reserved for the early cases, and physical agents have been substituted in the others as offering the greatest amount of relief for the longest period. There is no good reason why such a principle should not be applied in carcinoma of the breast as well.

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CARIES OF THE COSTAL CARTILAGES FOLLOWING RELAPSING FEVER

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RELAPSING fever is uncommon in the United States, and is seldom seen except in the Coast cities. During the war it appeared in epidemic form in the Near East, and the writer encountered it in Asia Minor and northern Persia, which lie well within the temperate zone. Like typhus fever, relapsing fever is a filth disease and is favored by war conditions, with the inevitable crowding and pediculosis. Its relationship to typhus is pointed out in the Allbutt, Osler, and other systems of medicine. What relationship, if any, exists between the spirillum of Obermeier, the causal agent in relapsing fever, and the virus of typhus is yet to be determined.

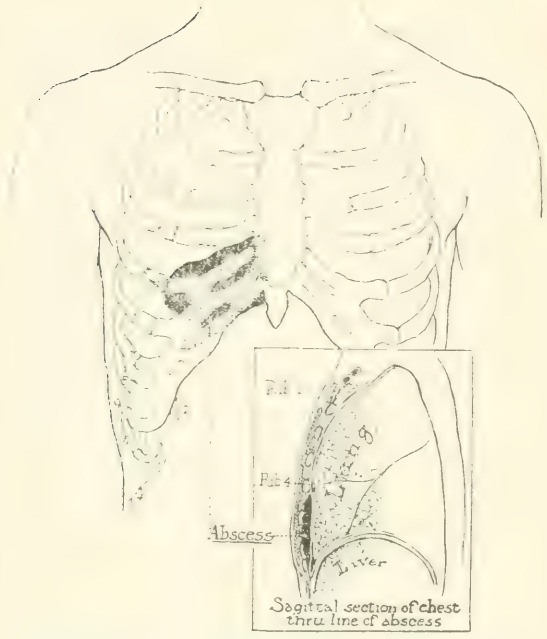
During the early years of the war, the writer was in Asia Minor and was able to verify the statements in Allbutt's *System*, for an epidemic of relapsing fever appeared in the spring and summer of 1916, being preceded and followed by violent epidemics of typhus.

During the winter of 1918–1919, the writer was in Persia and witnessed a severe epidemic of relapsing fever in Teheran, which followed a visitation of typhus that had ravaged the city for 3 years. The course and symptoms of relapsing fever during this epidemic were unusually severe and the American and British physicians learned to "spot" the cases as they crowded into the clinics by the early prostration and the appearance during the first few days of icterus in the conjunctivæ. Under the local conditions little bacteriological work could be done, but the discovery of Obermeier's spirillum in the blood in a number of cases established the character of the epidemic beyond a doubt.

The standard remedy for relapsing fever is neosalvarsan. An average dose of 0.3 gram given intravenously causes a rapid fall of temperature with profuse sweating, and usually terminates the disease. Sometimes the dose must be repeated; occasionally neosalvarsan seems to have no effect.

The interesting feature of the epidemic from the surgical standpoint was the sequel of caries of the costal cartilages. In 3 weeks in Teheran, the writer saw at least half a dozen cases of costal caries, and heard of many more. The history given was of pain and swelling over the front of the chest during the illness, not subsiding during convalescence, with abscess formation a few weeks later. The upper and middle cartilages were attacked, from the third to the eighth. The course of the infection was afebrile and marked by great indolence, resembling similar infections following typhoid fever.

The only treatment, of course, is surgical. The caries invariably begins on the posterior aspect of the cartilages and on reflecting the superficial tissues a small sinus is found between two cartilages leading down to an abscess between the bony thorax and the pleura, with the posterior aspect of the cartilages carious and worm-eaten in appearance. These abscesses burrow under the ribs and sternum but do not often rupture into the pleural cavity. Instead the pus finds its way around the cartilages and burrows forward through the superficial tissues. Bismuth roentgenograms do not show the full extent of the infection, as the channels are often minute, and foci of infection in the cartilages become almost occluded from the general abscess cavity, which is flattened between the pleura and the bony thorax much as a drop of ink spreads out into fantastic shapes when pressed between two sheets of glazed paper. Careful and thorough removal of the infected cartilages is necessary; the operation cannot be done in a hurry, but hidden sinuses must be carefully searched for and all overlying cartilage freely resected. Extensions toward the sternum are serious on account of the damage to the internal mammary artery. One of the writer's cases was nearly lost by erosion of the walls of this vessel several days after operation. Cartilage



Typical abscess originating in the costal cartilages and lying between them and the pleura. The shaded portions are covered by cartilage and bone, which must be resected for drainage. The chief danger lies in wounding the pleura and the internal mammary artery.

has very low powers of resistance, and it is difficult to keep cleancut surfaces from becoming re-infected even after the diseased foci have been removed. Carrel-Dakin treatment is usually contra-indicated for fear of erosion of the pleura. The wound should be thoroughly disinfected at the close of the operation and left as wide open as possible, with drainage so arranged that no pus can dam up against exposed cartilages, as otherwise re-infection and burrowing are liable to take place. The staphylococcus after once invading the skeleton is not easily dislodged, and this is especially true of the thorax, particularly when the infection reaches the interarticulations of the sixth, seventh, eighth, and ninth cartilages. Sometimes a series of operations must be performed and the prognosis should be guarded.

The writer himself was a victim of relapsing fever in Teheran and takes this occasion to report his own case:

Patient was engaged in medical and surgical work in Teheran, Persia, and examined and operated upon cases of relapsing fever. He took precautions as to wearing gowns, etc., does not remember finding any pediculi on person. In usual health until March 20, 1919, when after a few hours of malaise and general aching pains, fever commenced and rapidly rose to 104°, with rigors, and intense headache. Jaundice appeared on third day of disease. Spleen somewhat enlarged. No spots. Four blood examinations showed neither spirilla nor malarial plasmodia, though there was evidence of red cell destruction. Leucocytes 6,400. March 24, profuse sweat; temperature fell to subnormal and remained there 2 days when slight parotitis appeared and temperature again rose rapidly to 104.5°. Irregular fever for 4 days more, with another profuse sweat and defervescence on March 30. As the blood examination was negative during the first attack, the treatment was symptomatic; during the second attack 0.3 gram of neosalvarsan was given intravenously followed by intramuscular injections of quinine. During the second paroxysm, patient noticed a small swelling over the fifth right costosternal articulation which became exquisitely tender and persisted throughout convalescence, though the tenderness subsided somewhat. There was no return of fever during convalescence and the patient went to Constantinople *via* Baku and Batoum, and the swelling seemed to be subsiding. On May 4, he was exposed for 3 hours in an open rowboat to a cold wind while going to his destination on the Bosphorus. A laryngeal cough developed and persisted several days; with the increased motion in the chest the swelling increased in size and became painful. Simultaneously toothache commenced in a filled bicuspid, and a small abscess developed at the root, which was opened, drained for several days, and the tooth was refilled but eventually had to be drawn. The swelling at the fifth costosternal junction slowly increased, but without fever or fluctuation, and painful only on coughing or pressure. Local applications without definite result. By June 3, an abscess had developed which had to be opened. No bacteriological examination could be made at the time but later the discharge showed only staphylococcus pyogenes aureus—no spirilla or other organisms. Since that time, the writer has undergone several operations, increasingly radical, until with the removal of sections of the fifth, sixth, and seventh cartilages and ribs, recovery now seems assured.

This redoubtable sequel of relapsing fever is worthy of note, and is not dealt with in the textbooks. Special emphasis should be placed on the site of infection, *i.e.*, the posterior aspect of the costal cartilages and the low resistance of the cartilages themselves, which together account for the extensive burrowing and call for radical resection of the overlying tissues in order to give adequate drainage and prevent re-infection.

MISSED ABORTION

By A. J. RONGY, M.D., F.A.C.S., and S. S. ARLUCK, M.D., New York

THE subject of missed abortion, from a diagnostic standpoint, baffles even the most astute clinician. The history and symptoms elicited from patients which in the main are purely subjective, are so vague that the family physician or specialist has very little data upon which to base his conclusions. The average woman for some reason pays very little attention to the slight irregularities which occur during pregnancy, especially any pathological condition which is not accompanied by pain or severe constitutional disturbances. As soon as a woman becomes pregnant and nothing unusual such as hæmorrhage takes place, she almost always awaits the calculated time when childbirth is expected to take place.

There are two periods in the history of pregnancy which the patient considers of importance. First, the time of quickening, and second, the date of the expected birth of the child. Both incidents, as far as the patient is concerned, are filled with distorted but popular notions which assume almost a mystic aspect. Usually, the newly wed daughter who becomes pregnant, is led to expect fœtal movements about the middle of the fifth month, but her mother, friend, or neighbor will kindly volunteer the information that a woman may not feel her baby until the seventh month and therefore should not worry if she fails to feel life earlier. The same is true of the durations of pregnancy. These faulty popular conceptions concerning pregnancy lead many women astray, and they therefore do not seek competent medical advice at a time when the diagnosis of missed abortion could more readily be established.

One is greatly impressed by the paucity of published data on this subject in recent years. A perusal of the literature soon convinces one how little has been said about it during the past decade. To our minds, the reason for this is the fact that this anomaly occurs very infrequently, and even large clinics offer very few cases for study and investigation. However, a close scrutiny of the material which presents itself, either at the office of the consultant or in the hospital ward, will very often bring out the very interesting fact that in many cases of so-called inevitable and threatened miscarriage death of the fœtus with cessation of growth of the product of conception had taken place some weeks to months earlier.

That this actually occurs is very important from a medicolegal standpoint. A pregnant woman who falls and receives a blow producing disturbance of the intra-uterine physiology, will usually show signs and symptoms of abortion within 24 to 48 hours. However, occasionally there may be present sufficient intra-uterine disturbance to cause the death of the fœtus yet not enough to induce uterine contractions with subsequent expulsion. This fact must be borne in mind by those engaged to give expert testimony, for if, for some reason, this possibility is not considered an injustice may be done to either party concerned.

Before entering into any further discussion on the subject, we must clearly understand what is meant by the term "missed abortion." A study of the literature on this subject reveals the fact that there is a lack of unanimity on the part of many authors as to what the clinical manifestations must be in order to apply the term of missed abortion to a given case. Ernst Frankl who made a careful survey of this subject, defines missed abortion as the intra-uterine death of the fœtus, prior to its viability, with the complete retention of the product of conception for the normal duration of pregnancy or longer. Matthews Duncan, who first described this condition, evidently did not limit himself to the narrow definition which Frankl gave it some time later. He maintained that all cases in which there is death of the fœtus before term, having local or general symptoms of abortion, followed by a period of quiescence, lasting to term or longer, should be classed as missed

abortion. Dessekker, in his report of a case, fails to adhere to the definition of either Frankl or Duncan.

While it may be difficult to formulate all the criteria which would be embraced in a definition of this condition, it seems to us that there must always exist two factors clinically, which would decide in favor of a diagnosis of missed abortion: first, it must be definitely established that cessation of growth of the product of conception has taken place; second, *pari passu* with the death of the fœtus, the uterus ceases to grow. Clinically, it is impossible in cases of early pregnancy to tell precisely when death of the fœtus actually occurs. A dead fœtus may be retained *in utero* without producing any local or constitutional symptoms and therefore the patient will not seek the advice of a physician. It is only after the fœtus has been dead for some time, when the patient fails to notice either enlargement of the abdomen or fœtal movements that she usually becomes anxious and consults her doctor. A careful examination of such a patient will elicit the fact that the history of pregnancy does not correspond with the size of the uterus. Usually these patients give a history of cessation of menstruation of from 5 to 6 months and the size of the uterus indicates a 3½ to 4 months' pregnancy. Such clinical findings must arouse the suspicion of the physician as to the possibility of the death of the fœtus but he will naturally refuse to commit himself to a positive statement. He should assume a conservative attitude and advise the patient to return for another examination 3 to 4 weeks later. If on re-examination, the size of the uterus remains unchanged, or on the contrary, has become even smaller and more or less doughy in consistency, a diagnosis of missed abortion at this time is almost justifiable. We believe however, that even at this point, active interference should not be instituted and that unless the patient is beginning to suffer from toxæmia due to the absorption, she should be allowed to continue for a further period of 3 to 4 weeks. If at this examination it is discovered that conditions still remain unchanged, active interference is absolutely indicated.

The inference which we wish to draw is that no patient who is carefully observed and in whom the diagnosis of missed abortion is definitely established, as outlined above, should be allowed to retain the product of conception until the supposed date of confinement or longer. Reasoning on this basis, we fail to see how the definition of Frankl is tenable. Frankl in his thesis refuses to include any case in which death of the fœtus had taken place during the early months, and which was not retained for at least the entire period of normal pregnancy. We feel that such practice, in the light of present knowledge, is not justifiable, for we see no reason why we should permit a patient to continue to retain the product of conception after a positive diagnosis has been established. On the contrary, not infrequently dangerous symptoms may arise if active interference is avoided. Cases of this nature are reported by Frankl and Dessekker. That this condition when neglected, may even cause death, is best illustrated by the cases reported by Kulenkampff and Litzmann. In their cases the fœtal parts perforated the uterine wall, causing peritonitis and resulting in death. We believe that Frankl's definition for missed abortion was to a large extent influenced by the trend of medical thought at that time. In those days, active uterine manipulation, during the pregnant state, was not commonly resorted to and therefore patients in whom a definite diagnosis was established were allowed to continue in that condition with the hope that natural forces would eventually cause expulsion. Also that a great number of his cases came for medical advice very late, some approaching the expected date of confinement when first examined. He like many others believed that uterine contractions are most likely to set in toward the end of pregnancy, and he therefore left them alone.

We realize that it is difficult to put forth a concrete definition of this condition which would guide both general practitioner and specialist in determining when active interference should be instituted in cases in which death of the fœtus has taken place, because not infrequently a mistaken diagnosis may

be made, even after most careful observation of the patient. However, for clinical purposes and in view of the great advances made in obstetric surgery, we offer the following definition: intra-uterine death of the product of conception, with its complete retention and absence of progressive enlargement of the uterus, as evidenced by repeated examinations covering a period of at least 8 to 10 weeks. These conditions having been established, we believe that active treatment should be instituted and we fail to see the reasonableness of the argument advanced by those who maintain that no active treatment is to be carried out, relying upon the natural forces to expel the uterine contents. Once intra-uterine death of the fœtus has been definitely established, it must be looked upon as a foreign body and treated accordingly.

ETIOLOGY

Under this heading there are practically two abnormal conditions which must be taken into consideration: first, the death of the fœtus; second, the failure on the part of the uterus to expel it. The causes for intra-uterine fœtal death are obviously very difficult to ascertain and but seldom are we able to demonstrate the pathological factors which might have taken place before death of the fœtus actually occurred. All of the theories heretofore set forth are not supported by practical pathological or biochemical studies, which necessarily are essential to establish the true cause beyond any possibility of doubt.

It seems that most observers agree that death of the fœtus takes place because of faulty metabolism either in the product of conception as urged by Leopold, or because of some disturbance in the maternal metabolism as advanced by Schatz. That such theories are merely speculative and do not seem to coincide with the clinical aspect of this condition, we are sure no one will doubt, for how often is this condition observed in women who are apparently in the best of health and in whom no disturbance of metabolism can be detected. Again, many a patient suffering from organic disease leading to severe constitutional disturbances, goes through the child-bearing period normally. Our personal observations lead us to believe that intra-uterine death of the fœtus takes place more often in women who are not only possessed of normal health but are seemingly in the best of health, not in women who are under weight but rather in women who are overweight. It is the patient who is abundantly supplied with fat and weighs more according to accepted standards who is prone to such disturbances. This fact is most clearly demonstrated in patients who suffer from the condition commonly termed "habitual abortion." An apparently healthy woman will seek the advice of a physician because she is unable to carry to full term. The recital of her case is usually most interesting and is about as follows: Shortly after marriage the patient became pregnant, carried 10 to 12 weeks, and aborted. Four or five months later she again conceived, but at the end of 12 or 14 weeks she again aborted. A third pregnancy has terminated in about the same way. Each succeeding pregnancy lasts a few weeks longer but suddenly for some unknown reason, pains set in and the product of conception is expelled.

Thorough investigation of such patients does not disclose any organic disease either local or constitutional, or any metabolic changes at present known to us. Still, there must undoubtedly exist some definite cause for the repeated death of the fœtus. The fact that we are unable to trace the etiological factors simply demonstrates that there are many processes controlling intra-uterine life which are entirely unknown to us.

Recent study of the glands of internal secretion seems to point to the fact that practically all physiological processes of the body are to a great extent influenced by them. Many clinicians today attribute the disturbances occurring in relation to menstruation, pregnancy, labor, and lactation, to some derangement of function of one or more of these glands. No one at present doubts that for normal menstruation there must exist normal ovarian function. Furthermore that conception, pregnancy, and labor are governed directly by the ovary in conjunction with the pituitary, thyroid, and possibly other internal secretory glands. Reasoning *a priori*, would

it not be logical to suppose that any disturbance in the physiology of the ovary might lead to interference with the normal progress of pregnancy?

That the above is true is certainly borne out by clinical experience. Women who menstruate irregularly, at intervals of 3 or 4 months, are more frequently sterile, and if such women do conceive, the chances for pregnancy to terminate normally are unfavorable. It is also true, that not infrequently pregnancy may be brought to normal termination in patients who have repeatedly miscarried, by the administration of one or more of the endocrines. At this point, it may not be amiss to cite the history of a case as an illustration of what may be accomplished with such patients.

Mrs. L. N., age 33, married 7 years, became pregnant 2 months after marriage; miscarried about 4½ months. About 1 year later again became pregnant, carried 3½ months with a similar result. Several months later she again became pregnant and miscarried at the same period of gestation. Another pregnancy followed and patient aborted at the end of 8 weeks. In June, 1919, patient again became pregnant and at the eighth week began to spot and stain. She was given a series of injections of lutein extract and the bleeding subsided. Pregnancy continued uneventfully until the fifth month when abdominal pain with considerable uterine bleeding again appeared. Lutein extract was again injected every other day for 1 week and hæmorrhage ceased. The injections were continued at intervals of one week until the seventh month. The pregnancy continued normally until term and patient was delivered at the Bedford Maternity of a living male child.

From the above and a number of similar cases which have responded with equally good results, we are compelled to assume that there is a definite and almost specific action on the part of the endocrines in relation to those functions of the woman which are peculiar to the child-bearing period, and that in the near future such disturbances will definitely be accounted for by some derangement in the endocrine system.

Just as it is difficult in a great number of cases to understand why death of the fœtus takes place, so much more difficult is it to explain why expulsion fails to follow. Ordinarily, as soon as the product of conception becomes a foreign body, uterine contractions set in and it is expelled. Occasionally however, the uterus fails to contract, and the dead fœtus is retained for periods varying from a few weeks or months to as long as 7 years, as reported by Freund.

What prevents expulsion of the uterine contents? All the known theories regarding the onset of labor fail reasonably to explain why uterine contractions do not take place in missed abortion. The generally accepted cause for expulsion of early pregnancies is that the product of conception, after its death, becomes a foreign body and as such is acted upon reflexly by the musculature of the uterus, and its expulsion is accomplished. If expulsion does not take place, there are only two factors which may prevent it: first, the pregnancy is not totally dead and therefore is not truly a foreign body; second, an ingrowth of the chorionic villi may take place into the musculature, weakening the walls of the uterus to the extent that it is incapable of contraction, and therefore the product of conception is retained. With the latter condition we are not for the present concerned.

It seems to us that the rapidity with which a dead fœtus is expelled from the uterus depends greatly upon the mode of its death. Clinically, miscarriage must be classified into three distinct groups, depending upon the time consumed from the onset of symptoms to its termination.

1. The acute variety in which the onset is sudden, manifesting itself by hæmorrhage, promptly followed by strong contractions and expulsion. Examination of fœtus and placenta reveals the following: A large blood clot occupies practically the entire uterine surface of the placenta, and the fœtus rarely if ever shows signs of maceration, but not infrequently there are manifestations of viability. In such cases the pregnancy is interrupted because of some disturbance at the site of placental implantation which is sufficiently great to cause its complete separation from the uterus. The entire product of conception is now a true foreign body and its expulsion promptly ensues.

2. In these cases the clinical course is less acute. The patient usually begins to complain of discomfort about the lower half of the

abdomen and of backache. Irregular spotting and staining follows and continues over a period of 2 or 3 weeks. At this stage the condition may right itself and the pregnancy continue, or contractions may set in and hæmorrhage follow and the product of conception be expelled. Examination of the placenta in such cases shows it to be studded with small hæmorrhage infarcts and many areas of calcification and necrosis. The fœtus is usually macerated showing that death had taken place some time before. In these cases, the disturbances which take place at the placental site, are insidious and the product of conception becomes a foreign body and is expelled only after the greater portion of the placenta has been involved.

3. In this group we have no means of actually studying the clinical course. The product of conception dies and is retained without producing symptoms. Death in such cases, we believe, *must primarily* take place either in the fœtus or because of some changes in the umbilical cord, and the changes which occur at the placental site are secondary in nature, developing very slowly, so that the circulation continues for some time and the product of conception does not really become a foreign body until complete disorganization at the placental site takes place. Expulsion therefore does not follow the death of the fœtus, but at some future date. We feel that in all cases of so-called missed abortion, death primarily takes place in the fœtus, because of disturbance on the part of the mother, such as tuberculosis or syphilis, etc., because of some pathological condition of the fœtus, or because of either mechanical or pathological disturbance in the umbilical cord, while in all cases in which expulsion follows the death of the fœtus, the disturbance is usually at the placental site.

DIAGNOSIS

The most frequent condition mistaken for missed abortion is fibromyoma of the uterus, especially when the tumor is soft, round, and even. However, a close study of the history of the patient will reveal the fact that the menstrual history is such that pregnancy may be eliminated. Not infrequently, patients who suffer from fibromyoma of the uterus have amenorrhœa for from 3 to 4 months, and the patient presents herself for a diagnosis stating that on previous examinations pregnancy had been suspected. It is very difficult to differentiate these cases and the treatment to be pursued in such patients is quite different, as will be pointed out later. Of great aid in the diagnosis of this condition, are some of the subjective symptoms which are usually associated with the early period of pregnancy. Close questioning will bring out the fact that in the early part of pregnancy the patient very often had nausea and vomiting. While these may not always be present, they are of material help in establishing a definite diagnosis.

TREATMENT

As in many other obstetrical conditions, it is difficult to adopt a definite plan of treatment. Each case must be studied individually and the treatment will depend upon the clinical symptoms, size of the uterus, and the condition of the cervix. In general, the rules governing our treatment are the same as in cases of inevitable abortion: curettage, when the pregnancy is 8 weeks or less; introduction of catheter into the uterus with tight packing of cervix at any time thereafter. All instrumentation must be carefully performed in missed abortion, for the product of conception is always more or less adherent and because of that the uterine wall is thin and friable and easily perforated. As a rule, when cases of missed abortion present themselves for treatment, the size of the uterus is such that curettage must be excluded as a means of emptying it. The plan of treatment greatly depends upon the condition of the cervix. Patients who have a long, thick, and conical cervix are anæsthetized, and the cervix dilated. A small, soft, rubber catheter is introduced into the uterus and the cervix tightly packed with gauze. When the cervix is soft and dilatation is not required, the same procedure is followed without anæsthesia. The catheter and packing are allowed to remain for 24 to 48 hours and if contractions of the uterus have not set in, the same treatment is repeated. However, it is but seldom

that pains do not set in within 24 to 36 hours especially when a small dose of pituitrin is administered as soon as the patient begins to show slight evidence of uterine contraction. Cases in which the uterine irritability is diminished do not as a rule respond to a single catheter and therefore we are obliged to use two or even more at the same sitting to induce uterine contractions. No harm can result from the use of two or three soft rubber catheters when properly introduced. In a great many instances the failure on the part of the uterus to contract is due to improper introduction of the catheter. In order to produce the desired result, it is absolutely necessary that the catheter reach the upper part of the uterine cavity and that all kinking be avoided. There should be little difficulty in accomplishing this for in cases at term the precaution necessary to avoid rupture of the membranes is entirely eliminated. Usually the uterine contractions which follow this method of treatment, are sufficiently strong to expel the product of conception completely. In a small number of cases, however, the contractions were not strong enough to cause expulsion and the placental forceps were employed. In these instances, the product of conception is partly separated. It lies in the lower uterine segment and is removed without difficulty with placental forceps. We found it advisable in all these cases to pack the uterus with 5 per cent iodoform gauze, in order to promote contractions and remove any remaining débris.

PROGNOSIS

It is difficult to state what the outcome in our cases would have been, had they been allowed to continue with their pregnancies. Undoubtedly, in some the uterine contents would have been expelled sooner or later, but we are sure that in at least three of our cases, spontaneous expulsion would never have taken place, for the retained product of conception was well organized and strongly adherent to the uterine wall.

To permit a patient who is suffering from missed abortion to continue the pregnancy, is in our judgment very bad practice and we are sure that in many cases untoward symptoms will eventually occur. We must repeat that we see no contra-indication for interference and that nothing can possibly be gained by waiting. Our experience is based on the clinical observation of 21 cases, in private or hospital practice, and in consultation with other physicians. Most of our cases ran about the same clinical course and therefore are not of sufficient interest to warrant a detailed clinical report. However, a few cases ran a course which we believe interesting enough to justify a detailed report.

Case 1. Mrs. O., age 26, married 6 years but never pregnant, came to consult me because she had not menstruated for two periods. On examination the uterus was found enlarged to the size of a 2 months' pregnancy. Patient was informed of her condition and was instructed to return in 4 weeks for further observation. On her return, patient stated that her gastric disturbances which had been quite distressing, had subsided and that she was now feeling quite comfortable. On vaginal examination the uterus was found to be about the same size as on previous examination. The lack of progressive enlargement of the uterus led me to suspect that pregnancy was not progressing normally. The patient at that time was not made aware of her condition but was told to return in 2 weeks. She was again examined and no progressive enlargement of the uterus could be elicited. At this time I definitely decided that the pregnancy had ceased to grow and instructed the patient to return in 4 weeks or sooner if any evidence of miscarriage appeared. At the end of 4 weeks, patient again appeared, complaining of irregular pains in the lower portion of the abdomen associated with occasional paroxysmal attacks of gaseous distention.

On examination the uterus was found to be somewhat doughy, having lost the resilience commonly found in the pregnant uterus. No further enlargement had taken place. At this time the patient was informed that the fœtus had died and was advised to have the uterus evacuated. The patient and her mother decided that it would be better to let nature take its course and refused to permit any active interference. She continued to have severe pain in abdomen, at times becoming colic-like in nature. The character of pain was such as is not infrequently associated with secondary abdominal pregnancy. At this time I asked Dr. J. Clifton Edgar to see the patient with me. After a careful examination we decided that it would be advisable to explore the uterus before any other procedure was undertaken. The family, however, again refused to accept our suggestion, for they thought of the likelihood of our being mistaken. At this stage the family physician was called to see the patient and I was later informed that he advised against any interference whatsoever. The patient continued to

suffer from severe abdominal pain until the supposed date of confinement and when labor failed to set in the family was convinced that there was something radically wrong with the patient and consented to her removal to the hospital. On exploration of the uterus, a large quantity of organized material was removed with great difficulty. Some of the tissue was closely adherent and extended into the uterine wall. The substance removed showed evidence of bony formation. Bleeding was not profuse but patient went into shock during the operation. The uterus was tightly packed with iodoform gauze. The patient made a slow but uneventful recovery and was discharged from the hospital at the end of 3 weeks.

Case 2. Mrs. M., age 29, III-para, pregnancies and labors normal, consulted me because she failed to menstruate for 13 months. On careful questioning she informed me that when she first ceased to menstruate she considered herself pregnant and in fact had all the symptoms which she had experienced in the early period of her previous pregnancies. On vaginal examination I found the uterus enlarged to about the size of a three months' pregnancy. The peculiar consistency and rotundity of the uterus led me to suspect a pregnancy which had ceased to grow about the end of the third month, and which was not expelled. After stating my opinion the patient informed me that she had consulted two prominent gynecologists who told her that she had a fibroid tumor of the uterus. Evidently the patient was very skeptical about my diagnosis, for when she returned to see me again, she informed me that she had seen another gynecologist and was again told that she had a fibroid of the uterus. Patient admitted to Lebanon Hospital. The fact that this condition was of long standing, and that the cervix was very hard and rigid, and that the pregnancy at this time was most likely organized and adherent to the uterine wall, prompted me to remove it by abdominal hysterotomy. On entering the uterine cavity, we found a calcified fœtus of about 3 months and closely adherent to the uterine wall the placenta which was separated from the wall with a great dea of difficulty. The uterine wall at some points was very much thinned out. The uterus was packed with iodoform gauze and the uterine wound closed. Recovery was uneventful; patient was discharged at the end of 2 weeks.

Case 3. Mrs. S. C., age 26, V-para. All labors and previous pregnancies had been normal. All children are living, the youngest 15 months old. On advice of her physician, patient came for consultation because of irregular spotting or staining during the previous 2 weeks. At no time had she missed a menstrual period, but noticed that during the last four periods the flow was scanty and of a shorter duration, lasting only 3 days instead of the usual 6 days. Vaginal examination disclosed an uterus enlarged to about three and a half months and a diagnosis of uterine fibroid was tentatively made. She was admitted to Lebanon Hospital. On opening the abdomen the uterus appeared too uniformly enlarged and smooth, and not withstanding her menstrual history it led me to suspect the possibility of an intra-uterine pregnancy with a dead, retained fœtus and accordingly instead of extirpating the uterus, I incised the anterior wall and found a fœtus about the size of 10 weeks. The placenta was hard but somewhat separated at the lower margin. After removing the uterine contents, the uterine incision was closed. Patient made an uneventful recovery and was discharged from the hospital at the end of 2 weeks. At time of operation, the patient requested that in the event the uterus was not removed, I sterilize her. I accordingly ligated both tubes with silk and cut them between the ligatures. Five months later the patient became pregnant and aborted at the end of 10 weeks.

Case 4. I am indebted to Dr. Otto Schwartz, of St. Louis, who kindly offered the following case history and permitted me to incorporate it in this paper. Mrs. E. C., age 18, admitted to Barnes Hospital, St. Louis, October 24, 1917. First visit was made to prenatal clinic August 29, 1917. The patient had been married one year. No previous pregnancy. Date of last menstrual period was January 21, 1917. History of pregnancy up to the first visit to prenatal clinic was uneventful, except for rather marked nausea during the first 12 weeks. Note from prenatal clinic October 4, 1917: fundus has not increased in height since August 29, 1917. Thirteen centimeters from symphysis.

October 23, 1917: the uterus was diminishing in size, was soft and fluctuating; fundus 12 centimeters above the symphysis. Fœtal movements first felt, June, 1917, and had not been noticed since the early part of August, 1917. Expected date of confinement from menstrual history was October 28, 1917. She was advised to enter hospital because she was having slight contractions.

October 25, 1917: Examination by Dr. Schwartz shows the abdomen slightly enlarged just below the umbilicus, where there is a moderate rounded swelling. The mass is distinctly palpable in the midline, extending upward from the symphysis to about 3 centimeters below the umbilicus. The mass is apparently of the size of a large grape fruit, boggy in consistency, freely movable, and rising from the pelvic structures. Vaginal examination shows the body of the uterus to the right and forward, the size of 18 weeks' pregnancy and boggy in consistency. No tenderness, masses or indurations were found.

A tentative diagnosis was made of missed abortion with subsequent formation of hæmatoma mole of mummified fœtus, and the patient was advised to have the uterus emptied. On October 26, 1917, the findings corresponded to a 5 months' pregnancy. As the case has been watched for some time and as the uterus is not enlarging but is getting even smaller, Dr. Schwartz suggested that the cervix be packed and the results observed. The patient was due October 28, 1917. On October 27, 1917, a 4 months' fœtus

was expelled at 8 a.m. One ounce of castor oil had been given the night before. The fœtus was dead and considerably macerated about the legs. The placenta was hard but intact. The cord was at the edge of the placenta, which probably caused it to be clamped off, and resulted in the death of the fœtus. The puerperium was uneventful and the patient was discharged November 6, 1917, at which time the uterus was well involuted, the cervix was closed and firm, and no adnexal mass or tenderness was present. The general condition of the patient was very satisfactory. No record of Wassermann reaction is given.

Case 5. Mrs. R., V-para; previous history, negative; came to engage me for confinement, supposedly in the seventh month of pregnancy. On examination I found the uterus corresponding in size to a 4 months' pregnancy, and told her that there was some discrepancy in the history; that she either became pregnant much later, after ceasing to menstruate, or that the fœtus had died 8 to 10 weeks before. She insisted that she had been feeling fœtal movements for the past 7 or 8 weeks. I asked her to return 4 weeks later. On re-examination I found the uterus about the same size and advised her to have it emptied. I referred her to Dr. J. Heller for treatment, who, in view of the fact that the patient was so near the supposed date of confinement, decided not to interfere. She continued with her pregnancy for about 3 weeks longer and spontaneously expelled a macerated fœtus, about 4 months' in size.

This case illustrates the point that when a diagnosis of missed abortion is made near term, the patient may be allowed to continue until the expected time, for there is always the likelihood that contractions will set in and expulsion ensue. However, all such cases must be carefully watched for symptoms of toxæmia due to absorption. In all the other cases of this series, active interference was instituted as soon as a positive diagnosis was established. All patients made uneventful recoveries. Our method of procedure in Case 2, we feel was fully justified in view of the local findings, and the great disagreement in the diagnosis. Case 3, shows how careful we must be before we undertake a complete hysterectomy, if on opening the abdomen, the appearance of the uterus is such as to arouse the suspicion of pregnancy. Under these circumstances, hysterotomy should always be performed, and if the findings are negative, followed by hysterectomy. Such precautions we feel would spare many a woman the ordeal which is usually associated with hysterectomy.

Finally we wish to state that a definite diagnosis of missed abortion may not infrequently be difficult to make. However, we feel that close observation of the patient during the early period of pregnancy, will in the majority of cases bring out that there exists a disproportion between the size of the uterus and the history of cessation of menstruation. This with the many other signs and symptoms that usually accompany this condition must sooner or later help definitely to establish the diagnosis, and once a diagnosis of missed abortion has been made, the uterus should be promptly emptied.

DEPARTMENT OF TECHNIQUE

X-RAY IN THE DIAGNOSIS OF PROSTATISM[1]

By H. McC. JOHNSON, M.D., F.A.C.S., San Antonio, Texas

UNDER the term prostatism are included those conditions of urinary difficulties of men caused by obstruction at the bladder neck whether due to glandular enlargement of the prostate, to fibrous changes in it, or to coarctation of the internal orifice of the bladder.

The diagnosis of prostatism is usually based upon: (1) the symptoms, that is, the lack of force to the urinary stream, and frequency, especially in the early hours of the morning; (2) the presence or absence of enlargement, and the consistency as palpated per rectum; (3) the urethral length and amount of residual urine; and (4), as a method of precision, the use of the cystoscope, by means of which we discover whether there is a median or lateral enlargement, fibrous ring or tab; we note the presence of calculi, trabeculæ, saccules, the opening of diverticula, if present, and observe the ureteral orifices. There are, however, conditions that will escape these methods of examination. The cystoscope will not tell us the size and shape of a diverticulum or the presence of prostatic calculi. It may overlook a small opening to a diverticulum or an encysted stone. We may note the condition of the ureteral orifices with the cystoscope but ureters dilated above the orifices are not within its scope. It requires a more accurate method to eliminate these sources of error. There are, also, cases where it is inadvisable to use the cystoscope or where cystoscopy for one reason or another is not satisfactory.

Again, it is surprising how often we will run up on unsuspected conditions if we will look for them, even in those cases that seem perfectly obvious.

Fig. 1. Air in bladder. Bilateral hypertrophy.

Fig. 2. Ten per cent sodium iodide in bladder. Diverticula.

Read before the Texas Surgical Society, May 5, 1920.

Fig. 3. Prostatic calculi.

Fig. 4. Air in bladder (2 years after suprapubic prostatectomy) showing a smooth internal ring.

At times the differential diagnosis is not at all easy. It may require our best effort to separate the various kinds of enlargement, the sclerotic conditions, and retentions due to degenerations of the nerve supply, such as, tabes. More confusing is the fact that enlargement and sclerosis may be associated with a tabetic bladder.

While the X-ray of the bladder, with and without air, oxygen, or an opaque solution distention, has been used for some time, it seems little attention has been paid to a systematized technique whereby full advantage of the roentgenograph is taken as a routine.

George E. Pfahler in the *American Journal of Roentgenology*, August, 1919, describes radiography of the air-filled bladder and says: "The examination of the bladder for tumors by the expert cystoscopist has been so successful that this modified roentgen method has probably not been developed to the fullest advantage but there are many cases in which an examination by the cystoscopist is not practical for one of the following reasons: (1) because of the severe pain which generally accompanies these examinations; (2) because of the inability to pass the cystoscope; (3) because of severe hæmorrhage; (4) because of the decided objection on the part of the patient; (5) because an expert cystoscopist is not always on hand."

In the July, 1916, issue of the *American Journal of Roentgenology*, Amedee Grainger describes radiography of the oxygen-distended bladder and speaks of its advantages. Because of the fact that room air is easily obtained, is well borne, has been proved harmless, and gives quite good roentgenograms, we have selected it in preference to other gases. That air in the bladder is harmless is the daily observation of urologists. Kelly and Lewis have constantly used it in their methods of cystoscopy, and recently Dandy by spinal puncture has injected room air into the ventricles of the brain without deleterious effect.

In conjunction with Dr. Manning Venable and through the courteous co-operation of Dr. Hamilton, the following technique is employed: Three X-ray exposures are made. Plate 1 is made with bladder empty. Plate 2 is made with bladder filled with room air. Plate 3 is made with the bladder filled with 10 per cent sodium iodide or bromide solution. The object of plate 1, with bladder empty, is to locate calculi in the prostate, to locate free or encysted calculi in the bladder, and to outline in the bowel any gas that may be present and confuse the reading of plate 2. The object of plate 2, with the bladder distended with air, is to outline the enlarged prostate and other tumefactions. The object of plate 3, with the bladder filled with opaque solution is to outline diverticula, show the size and shape of the bladder, the presence of saccules or dilated patulous ureters.

Neither the X-ray nor the cystoscope is infallible, but they are very valuable as complements to each other, and when used as such and in conjunction with each other there is very small chance of error. We now employ roentgenography wherever possible in every case of prostatism, whether the cystoscope is used or not.

While the above methods have been used singly, we have found no descriptions of their use in the same manner as we use them. We have no doubt but that some of the unsatisfactory results following prostatectomy will be eliminated by the regular use of the roentgenograph as outlined above.

SUPERNUMERARY THUMBS

By J. CHRISTOPHER O'DAY, M.D., F.A.C.S., Honolulu, Hawaii

THE accompanying photograph of supernumerary thumbs is quite unusual inasmuch as the right hand had two distinct thumbs while the left had practically two thumbs quite completely webbed.

The extensors and flexors of the right proximal thumb enabled the usual motions of that digit while the distal thumb was inert because of the absence of either flexor or extensor attachments.

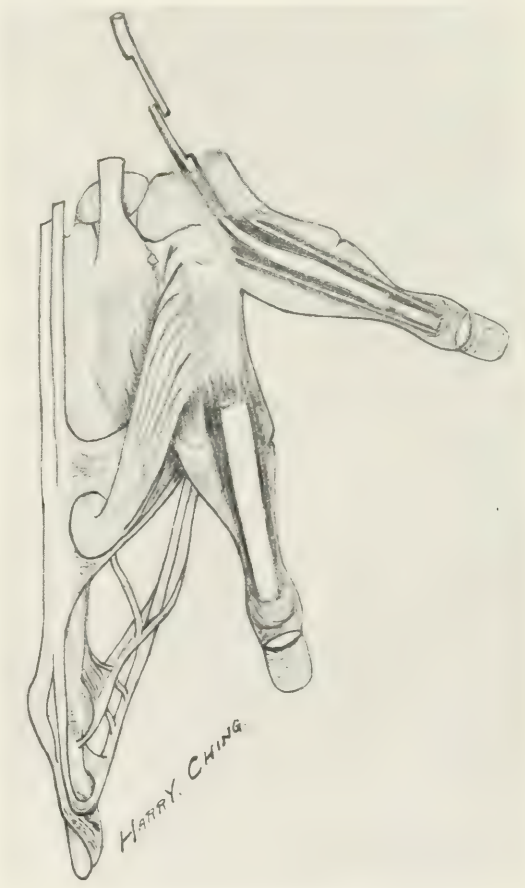
The diagram illustrates our method of transplanting, *en bloc*, each set. It was necessary to lengthen the tendons proximal to the wrist-joint in order properly to reach the distal thumb.

After such transplantation the proximal thumb was removed.

The thumbs of the left hand were dealt with by totally disregarding the webbed condition and merely removing the outside digit.

Complete function was restored to the inert distal right thumb.

Right hand has two distinct thumbs; left, two thumbs completely webbed.



Author's technique in correcting right hand.

CLEFT PALATE EXTRAORDINARY

By TRUMAN W. BROPHY, M.D., D.D.S., F.A.C.S., Chicago

IT IS common for a cleft to extend through the palatal plates of the maxillary bones as well as the horizontal plates of the palate bones and then extend forward, separating the premaxillary bones from the maxillary, including the alveolar ridge, thus forming a complete separation from the nostril back to the extreme distal end of the palate. Or, it may separate the premaxillary from the maxillary bones completely, and then extend backward in the median line to the end of the palate. I have never before, however, found a case showing a cleft of the palate in the median line, with the premaxillary bones separated at the central suture and the palate cleft throughout the entire length, nor does a careful review of surgical literature furnish a single example of a deformity of this character. So far as I know, the case recorded here for the first time is the only one of its kind.

This patient came into my practice in June, 1919, at the age of 14 months. She presented a deformity of far more than usual interest. On examining Figures 1 to 5 it will be observed that the palate was separated in the median line beginning with the premaxillary bones and extending backward the entire length of the hard and soft palates. The lip also was divided in the median line.

A central incisor tooth occupied each premaxillary bone. The extreme breadth of the cleft (Figs. 1 and 3) and the age of the child presented a problem which was by no means easy to solve. The lower teeth did not occlude with the upper teeth, but came in contact with the soft parts covering the palatal surfaces. Ossification had so far advanced that the bending of the bones and moving them together was impossible. Immediate closure of this broad cleft could be effected only by fracture of the bones. In a child of this age, fracture would be a very hazardous procedure.

After careful consideration I resolved to move the bones together by passing wire sutures through them, keeping the sutures above the hard palate. A double suture was carried through the bones in three different places. Heavy lead plates, No. 13 American gauge, were perforated in three places and double wires were carried through these holes and twisted upon the plates, a little force being applied so that the wires might be well tightened. Two anterior and two posterior wires were carried around anteriorly to the premaxillary bones and tightened. No further progress was made at this time.

Ten days later the patient was anæsthetized, the slack drawn out, and the wires tightened. From time to time, at intervals of about 10 days, this tightening process was repeated until at the end of the third month, without having particularly disturbed the patient, I found, to my delight, that the anterior parts of the cleft (the separated premaxillary bones) were in contact and the edges posteriorly were nearly so. After the parts were approximated, all the wires were removed and new ones placed in the anterior part through the openings occupied by the former wires. The surfaces in contact were freshened, the compact bone removed, and the cancellated bone exposed. The soft parts were sutured together and the new wires were so tightened that the freshened bones were brought into immediate contact. With the soft parts closed by horsehair sutures, the patient was dismissed and after a lapse of 6 weeks, the lip was closed. One month after the closure of the lip, the hard palate along the edges of the cleft was denuded of the mucoperiosteum which was united, thus completing the operation.

This case sets aside most emphatically the theory that has been advanced, to the effect that wiring of the bones and bringing them into contact in cleft palate patients cannot be done subsequent to the sixth month. In my early experience I believed that the maxillary bones should not be moved together after the sixth month, because at that time they were well ossified and the teeth were erupting. Since my experience with this child, I have moved together the bones in a patient of 4 years. I am satisfied that any young person who has a broad cleft of the palate may have the deformity overcome by wiring the bones together in the manner I have described and the palate subsequently closed with good results. Theories in regard to surgical procedures are of little consequence when set aside by facts in cases like this. The child is a healthy, vigorous girl.

The moving of the bones together by the slow process is not unlike the work of the orthodontist

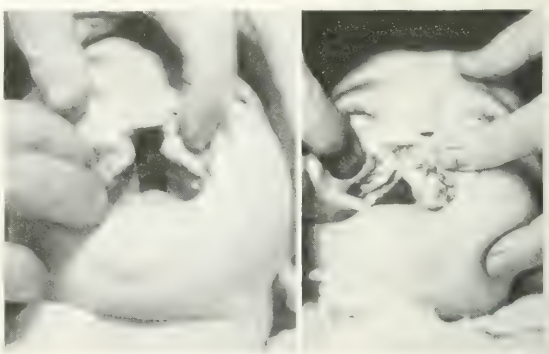
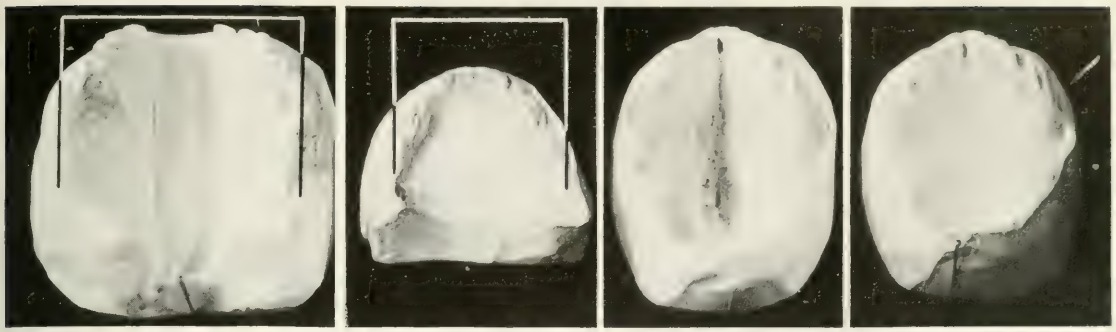


Fig. 1. Photograph showing complete separation of the upper jaw. The columna of the nose is attached to the left side, while the bones are separated exactly in the center.

Fig. 2. Photograph at the age of 17 months, 3 months after the sutures and lead plates were adjusted. It will be seen that the segments of the bones of the palate are in contact. (The wires and lead plates are visible in the photograph.) At this time all wires and plates were removed.



a *b* *c* *d*

Fig. 3. Photograph of casts showing comparative breadth of upper, *a*, and lower, *b*, jaws, the position of the teeth, and an accurate presentation of the separated bones. *c*. The bones in the anterior part of the hard palate are in contact, but the soft palate is not yet closed. *d*. Cast of the palate united throughout its entire length.

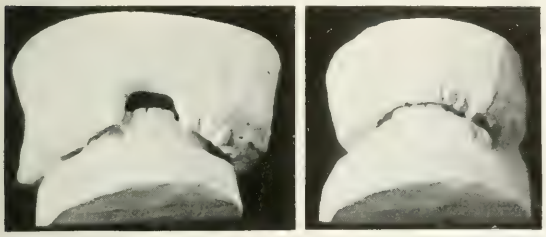


Fig. 4. *a* (at left), Cast of the upper and lower teeth. It shows that all the upper teeth telescope over the lower teeth; that the lower jaw, acting like a wedge, drives the segments of the upper jaw farther and farther apart. The lower teeth buried themselves in the soft parts of the hard palate, causing the patient great distress. *b*. Cast of the upper and lower jaws after the separated upper jaw had been narrowed to its normal width.

Fig. 5. Photograph showing child before and after operations were completed. The broad, flattened nostril on right side is corrected and vermilion border is perfect.

who, by his ingenious devices, moves a tooth or teeth to almost any location he desires, but he must move them slowly so as not to interfere with the circulation. In the vast field of oral surgery, as in other branches of surgery, new questions are constantly coming up, requiring most careful consideration before operation is made. And then, oftentimes, no precedents are to be found which will guide the surgeon in his work.

My experience in the war hospitals of France convinced me that in gunshot wounds of the mouth and jaws, the first impulse of the surgeon is to manipulate the bones by reconstruction so that they will occupy their proper places and, following this, plastic surgery may be more satisfactorily performed.

This case demonstrates most decidedly that any complete separation of the bones of the palate calls first for bone surgery. Plastics of the lip and soft palate should be performed in the order named. To have attempted to close this child's lip first, before the bones were approximated, would have been a great mistake. Had it been operated upon in early infancy, no doubt the traction of the obicularis oris muscle would to some extent have drawn the alveolar processes toward each other, but whoever so operated and concealed the more complicated deformity in the mouth would have left patient deformed for life.

INTERMITTENT OBSTRUCTION DUE TO GASTROPTOSIS[1]

By CHARLES DAVISON, A.M., M.D., F.A.C.S., Chicago
Professor of Surgery, University of Illinois

WHEN gastroptosis occurs to such an extent as to angulate the first portion of the duodenum, temporary obstruction may occur. The second portion of the duodenum is the most fixed part of the intestinal canal and furnishes a point over which angulation of the first portion of the duodenum may occur when certain conditions of prolapse, weight, and position of the stomach are sufficient.

The clinical history includes the usual symptoms of viceroptosis, but usually greater debility and emaciation are present. Attacks of temporary obstruction, apparently of the upper intestine, occur at varying intervals of from a few hours to several days. At times the recumbent position seems to be a factor in starting the paroxysm. During the attack there is pain in the epigastrium which is paroxysmal. There is emesis of the stomach contents and regurgitation of bile. The vomitus sometimes contains blood. After free emesis, the attack usually subsides. Constipation is generally present.

The Ewald test meal usually shows high acidity, a large amount of free hydrochloric acid, sometimes blood and bile, no lactic acid, no Boas-Oppler bacilli, no sarcinæ. There is usually slight leucocytosis.

The logical treatment of any obstruction is to remove the cause if possible; failing to do this, a visceral anastomosis is made to pass the obstruction. Supporting the stomach so that the duodenum cannot kink on itself, by palliative mechanical means, or by some method of reefing up the supports of the stomach would seem to be ideal, but is not sufficient. Posterior gastro-enterostomy seems to be necessary when the gastroptosis produces intermittent obstruction.

Case 1. M.G., American, housewife, age 42, entered University Hospital March 12, 1917, for operation for removal of gall-stones. Until one year previously the general health of the patient was good. At that time she began to have pain and discomfort in epigastric and right hypochondriac regions, especially after eating. Occasional attacks of paroxysmal, abdominal pain followed by vomit-

Fig. 1. Case 1. Rœntgenogram taken 10 minutes after barium meal, showing the distended stomach in the pelvis.

Fig. 2. Case 1. Rœntgenogram taken 16 hours after barium meal, showing the same position and distention of stomach, without passage of barium into small intestine.

[1]Read before the Chicago Surgical Society, April, 1920. (For discussion see p. 186.)

Fig. 3. Case 2. Rœntgenogram taken 10 minutes after barium meal, showing the entire distended stomach below the pelvic brim, without passage of barium into the small intestine.

ing occurred with increasing frequency and severity. These attacks would always begin while the patient was in the recumbent position and would last for several hours. The vomitus contained bile and the food contents of the stomach. Constipation was usual. Emaciation and prostration were marked. Her weight was 85 pounds, having lost 40 pounds during the year.

Ewald's test meal showed total acidity 90, free hydrochloric acid 55, no lactic acid, no bacteria, no blood, abundance of bile, leucocytosis 9,000.

A rœntgenogram, taken 10 minutes after a barium meal, shows an enlarged stomach prolapsed into the pelvis; good peristalsis of the stomach, but with little or no filling of the duodenum (Fig. 1).

A rœntgenogram taken 16 hours later shows the stomach still distended with barium; some peristalsis of the stomach still present, but the duodenum still empty (Fig. 2).

An unusually severe attack of paroxysmal pain and retching occurred during the night following the barium meal.

Posterior gastro-enterostomy was performed on the following day. The intra-abdominal examination showed the stomach to be large, muscular, and still containing barium. There was definite angulation of the duodenum, but no organic obstruction at the outlet of the stomach. The gall-bladder was empty.

Convalesence was rapid. She was relieved from the paroxysmal pain and vomiting.

At this time (3 years later) she is in good health, free from symptoms and following her usual occupation. She now weighs 195 pounds, having gained 110 pounds in 3 years.

A rœntgenogram, 3 years after operation, taken 10 minutes after ingestion of the barium meal, shows the stomach well out of the pelvis and emptying rapidly through the gastro-enterostomy, but not through the duodenum.

Case 2. J.W., American, sales manager, age 44, entered University Hospital, April 9, 1915, with the previous diagnosis of carcinoma of the stomach. His health had been poor for the past 6 years. His present illness began about 18 months previously with constant discomfort in the epigastrium, especially following meals, frequent attacks of paroxysmal pain, and vomiting. The vomitus contained food previously ingested, bile, and occasionally considerable blood. The paroxysms of pain would be temporarily relieved by vomiting. Constipation was usually present. Disability and prostration were extreme. His weight was reduced to 92 pounds.

Ewald's test meal showed total acidity 92, hydrochloric acid 64, no lactic acid, no Boas-Oppler bacilli, no sarcinæ, no blood. Leucocytosis 10,5000. Tuberculin test negative.

A rœntgenogram taken after a barium meal shows a large stomach prolapsed into the pelvis, without any filling of the duodenum (Fig. 3).

Posterior gastro-enterostomy was performed to relieve the obstruction. The intra-abdominal examination showed a large muscular stomach free from malignant or cicatricial obstruction to the pylorus or duodenum. The duodenum was sharply bent upon itself by the dragging downward of the stomach. With convalescence the symptoms were relieved and his health regained.

At this time (5 years later) he is in good health, free from symptoms and able to follow his occupation continuously. He now weighs 156 pounds, a gain of 64 pounds.

A rœntgenogram, 5 years after operation, taken 10 minutes after ingestion of the barium meal, shows the stomach emptying rapidly through the gastro-enterostomy and the duodenum.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

Regular Meeting, April 2, 1920, Dr. Charles E. Kahlke, Presiding

RENAL TUBERCULOSIS IN ADVANCED STAGE

Dr. Daniel N. Eisendrath: This kidney which is the size of the adult head was removed 2 days ago from a patient suffering from bilateral renal tuberculosis. The bladder showed typical tuberculous changes around the left ureteral orifice, but it was impossible to catheterize the right ureter. However, a large, somewhat lobulated tumor could be felt in the right kidney region. In order, therefore, to avoid direct operative exposure of this enlarged right kidney, we attempted to learn whether the enlargement was due to an advanced tuberculosis or not. Roentgenographic plates failed to show any difference in density in the shadows of the two kidneys.

At operation we found a typical advanced tuberculous pyonephrosis, as you can see from this specimen. In this case, therefore, roentgenography was of no value. Braasch, Colston, and Waters have recently directed attention to the advantages of roentgenography in just such cases where catheterization is impossible. The failure to obtain the typical shadow seen in many cases of so-called "putty" kidney or advanced caseous degeneration as seen in tuberculosis is due to the fact that the liquid contents of the cavities is of so thin a consistency as to fail to give an X-ray shadow other than that of a normal kidney.

Dr. M. L. Harris read a paper entitled "Local Anæsthesia in Breast Amputations."

INTERMITTENT OBSTRUCTION DUE TO GASTROPTOSIS

Dr. Charles Davison read a paper entitled "Intermittent Obstruction Due to Gastroptosis" (see p. 184).

DISCUSSION

Dr. A. J. Ochsner: The type of prolapsed stomach that Dr. Davison has shown us is the only one in which gastro-enterostomy will function, and it functions admirably. There is a large number of cases of moderate prolapse of the stomach in which the pylorus is carried to much lower level. Among them we have encountered a considerable number of failures, so that I believe the selection which Dr. Davison has made is a very wise one, and the test of it lies in the action of his barium meal.

Dr. Coleman G. Buford: I think that Dr. Davison has made a judicious selection of the type of non-malignant cases upon which to do gastro-enterostomy. There is one word of caution I must give, to those who are doing teaching. Be very careful to insist upon the limitations in the use of gastro-enterostomy in non-malignancy of the pylorus. If you do not do this, the beginner or the poorly trained man is too liable to attempt to shorten the invalidism of his patient by gastro-enterostomy, and he is too often encouraged to do this by the X-ray findings of a pronounced prolapse of the stomach with delayed emptying. I have seen too much of this. I have not taken part in more than nine gastro-enterostomies for non-malignant disease of the pylorus, aside from those done for congenital pyloric stenosis. I do not believe that surgeons have taken sufficient advantage of the teaching of the internists in connection with this matter of gastroptosis and its sequences. The medical men have obtained splendid results in many instances, through putting their patients to bed and giving them long periods of rest and forced feeding. Lately I am doing more for the class of cases referred to here than I did in former times. I am surprised, at times, at the great amount of comfort and general improvement that is afforded them by rest in bed, forced feeding, and symptomatic treatment.

Dr. Jacob Frank: I have noticed in the pictures that the anastomosis is made at the extreme end away from the pylorus. I believe it is the teaching of all surgeons who have been doing stomach work to make the anastomosis as near to the pylorus as possible. I would like to ask Dr. Davison whether he ignored that purposely, or whether he did it because he could not help himself at the time of the operation.

Dr. Karl Meyer: About 5 weeks ago I operated upon a patient at the Cook County Hospital who had had thirteen operations on her gastro-intestinal tract for Glenard's disease. She had been operated upon at the County and at other hospitals. I operated on her on account of an acute obstruction. The first operation she had was a gastro-enterostomy for the cure of gastric dilatation but without relief. The stomach was low down in the pelvis. At a second operation the ascending colon was attached to the parietal peritoneum, and as the transverse colon was shortened an acute obstruction followed. At another time a cæcosigmoidoscopy for stasis was

done. On account of the marked dilatation present between the cæcum and sigmoid it was necessary for me to release the ascending colon and remove the ascending, transverse, and descending colon, a difficult procedure on account of the acute obstruction present.

Unless we have definite obstruction, gastro-enterostomy is a surgical procedure that should be done with caution. In those cases in which there is occlusion at the pylorus a gastro-enterostomy will effect a cure, but in doing it for gastroptosis, or doing a short-circuiting operation in Glenard's disease a great deal of caution should be used, as Dr. Buford and Dr. Ochsner have pointed out.

Dr. William M. Harsha: The experience I have had with gastro-enterostomy bears out what has been said here; that in the majority of cases of gastroptosis associated with general enteroptosis, it is not good surgery.

Dr. M. L. Harris: Outside of ulcers, I think the only indication for gastro-enterostomy is a mechanical obstruction at the outlet of the stomach. If we have no mechanical obstruction, gastro-enterostomy will do no good. If we have mechanical obstruction, gastro-enterostomy should be performed.

Dr. Davison (closing): Gastro-enterostomy is not indicated in uncomplicated viceroptosis. I think that this position is entirely sustained by the experience of surgeons of repute.

I believe that gastro-enterostomy is indicated in viceroptosis when there is obstruction. Gastro-enterostomy is an operation primarily for the relief of obstruction and should be performed in the presence of general viceroptosis when there is chronic intermittent obstruction at or near the exit of the stomach, due to kinking or twisting of the flexible part of the duodenum, produced by the changing position of the prolapsed stomach.

The opening in the stomach should be made at its most dependent part when distended, which may give the roetgenographic appearance of a high operation when the obstruction has been relieved and the stomach has retracted nearly to its normal size.

Dr. Allen B. Kanavel read a paper entitled "Some Experience in Plastic Surgery."

CORRESPONDENCE

THE TREATMENT WITH RADIUM OF CANCER OF THE BLADDER

A Correction

To the Editor: Please permit me to correct an error in the brief article on "The Treatment with Radium of Cancer of the Bladder," by Dr. Lewis and myself, which appeared in the September, 1920, issue of Surgery, Gynecology and Obstetrics.

The erroneous statement is made that "a gram of radium at one-fourth inch from the vaginal wall for one-half hour" is a proper treatment. This should be corrected to "one-half gram." And farther down the memorandum is made that "5 centimeters or more of emanation is embedded, etc." This should, of course, have read "5 millicuries" of emanation.

Until these terms are better known, I think it would be well in each instance to spell out "millicurie," as in putting matter in type the abbreviation "mc." might so easily be interpreted as a slip for "cm."

Howard A. Kelly.

Baltimore.

JOHN G. BOWMAN

AT the beginning of the new year, Mr. John G. Bowman, Director of the College during the past six years, goes to the University of Pittsburgh as its Chancellor. He goes with the singular good will of the Regents and of the Fellows of the College; and he goes with such opportunities of usefulness in Pittsburgh that he had no option as to whether or not he should accept the new work.

At a meeting of the Regents of the College, held December 14, 1920, Mr. Bowman was made, on motion of Dr. Ochsner, an honorary regent of the College. Why such action was taken every Fellow will appreciate. As Dr. C. H. Mayo put it at the time: "We shall not allow Mr. Bowman really to go away."

At this meeting of the Regents Mr. Bowman presented a letter in which he stated the fundamental principles which have evolved about the policy of the College since its beginning. It is a statement of the principles which illuminate the repetitive drudgery of surgery into a privilege of service. There is no false note in it; there is religion in all of it. He keeps his feet on the ground while he looks at the rainbow.

The letter of Mr. Bowman is given in full below. It is worth a thoughtful reading. It is a statement of the policy of the College in the past and it is a statement of the policy of the College looking toward the future. "The great thing," the letter says, "both socially and scientifically, is not to avoid mistakes, but to throw all mistakes and successes as they occur under such review that they can be utilized for increased intelligence in the future." That statement is the basis of the hospital standardization program of the College. The truth in it is the reason for the success of the program. It does not limit the "initiative, freedom, or foresight" of the doctor in his work. Its soundness seems beyond debate.

"Progress," Mr. Bowman says, is "forever a process of change." But he points out that this change must be guided by intelligence and courage if the progress is to be worth while. In so far now as the College is an agency for constructive progress, the statement throws responsibility upon the individual Fellow. The concern of each Fellow is to effect this change or that which shall remold the practice of surgery nearer to the heart's desire. The College has certainly won national respect for its constructive work and its policy, as here stated, differentiates it from other medical societies. The letter follows:

To the Regents of the American College of Surgeons.

Gentlemen: As most of you knew in advance of the decision, I am to go to the University of Pittsburgh about the first of the new year. No letter of resignation from me seems now to be needed. But I do desire to set down in barest black and white my grateful appreciation of your kindness and good will through our six years' work together.

Since the beginning of work with the College, I have never doubted its worth. Rather, as was possible only through experience, my confidence in it has increased. I believe that you also find these conclusions in yourselves. But, looking for-

ward, let me discuss here briefly some of the ideas which we have evolved together in the policy of the College.

The usefulness of the College depends upon its power to project a better future in the science and practice of medicine and to assist in the realization of that future. Such a program of action concerns itself necessarily with principles, not dogmas; with principles to be tried, corrected, expanded, or rejected as, under the test of experience, they prove or fail to prove their value. It necessitates an alert open-mindedness to re-adjust ideas and habits which have hardened through long years into custom. Progress in the practice of medicine means forever a process of change based upon our intelligence and courage to utilize experience.

No group of men in the world, it seems to me, have in the last decade so clearly demonstrated their desires and capabilities to utilize their experience for the advancement of their work as have the Fellows of the College. One of the most vital problems, however, with which these men struggle today seems to me especially to demand our clearest thinking. That problem is to cause the purpose or the idealism of medicine to interpenetrate with the scientific or technical side of medicine.

To the Fellows of the College life is practical. The force of circumstance compels them onward. The future which they cast for themselves is an immediate one. They are impatient for results. In this swift current of action the Fellows sometimes look upon the technical details of surgery as upon details of business; and in performing operations they may confuse self-confidence, vitality, and technical capacity on the one hand, with their intentions, purposes, or ultimate motive of service on the other. Some may even plod through diagnoses and operations with tedium and dislike, failing to put faith or the force of conscience into each step which would sweep them on through a life, not colorless, but filled with inspiration. When this confusion occurs, the result is both disappointment and irritation; and then come protests and discontent with the practice of surgery.

On many an occasion I have interpreted such expressions of protest as meanness. In this I was wrong. The cause of the irritation is not meanness; the real cause in nearly every instance is undiscovered by the men who express their irritation. It lies in the failure of the individuals to adjust and to control present customs, traditions, institutions, and their own temperaments in relation to the requirements of modern surgery. The intellectual process of surgery and the repetitive details are cold and uninteresting to them because divorced from aspiration. The true interpretation of the situation is, in my judgment, that the protests are inwardly kind and really intended to be helpful. They are cries in the dark. The fact that such protests exist is evidence of wholesome unrest and is a valid indication of desire for light which means progress.

If we admit that good in this world endures only through communication, and that the purpose of the surgeon is to create happiness, relief of pain, and the prolongation of life, then we cannot escape the conclusion that the work of the surgeon is involved in that region at least on the borderland of religion. His life is inseparable from high emotional content. The difficulty now rests in the fact that this inherent emotion, or let me say, idealism, in the practice of surgery today fails in many instances to interpenetrate with the science of surgery. The

faith of the surgeon does not fuse with his technical work; the repetition of operations becomes unilluminated drudgery; or, as we say, the surgeon fails to make "religion" of his work. This fact, in my opinion, is both the chief cause of discontent in the medical profession and the outstanding obstacle to progress. As fusion of high purpose and of scientific proficiency is accomplished, then will follow the triumph of surgery and, in fact, of all medicine. Details of work day by day will then be as a privilege of service filled with inspiration; and to earn a living in medicine will also be to live a life through which happiness spontaneously breaks out.

But how is the administration of the College to hasten such an end? Certainly not by sentimental propaganda nor by insistence that men by effort of will knit higher motives into their work. The process must be one largely of absorption through example; and this policy is exactly the one upon which the College is now engaged.

First, the clinical meetings being held in the various states and provinces are designed, in part, to convey scientific information to those present. This is important, but it is only a minor purpose. The larger purpose is to set into motion swifter vibrations among those present as to the basic meaning of surgery. Perfection of technique, simplicity to the last degree, and gentleness in an operation may be taught by example; and so may the force of conscience and faith be shown by work when they are really present in the work. In this way conscience and faith may be transmitted to men and inspire them to their highest effort. When inspiration and not dislike radiates from each motion of the hand of an operator, the lesson will penetrate to the heart. The effect of such contact at these clinics may be unmeasurable, but it is certain and lasting.

Second, stimulus to the conscience of the profession comes through the hospital program of the College. The great thing underlying all of this work, both socially and scientifically, is not to avoid mistakes, but to throw all mistakes and successes as they occur under such review that they can be utilized for increased intelligence in the future. This means the regular and orderly use of experience. How great a factor conscience must be also in such review is obvious. The plan is one for collective efficiency and is in no way a block to individual initiative, freedom, or foresight.

Third, both the clinical meetings and the hospital program aim to stimulate in the public a desire upon a rational basis for the realization of the practice of medicine as it ought to be. The reaction of the public, then, upon the profession is at once swift, wholesome, and effective.

In conclusion, let me repeat that for many years to come at least your task is to make the motives of surgery articulate, first, to the surgeons themselves and, second, to the public. Headway in this aim will be abundantly reflected in scientific progress. For your clear insight and for your courage to proceed along such principles you have my highest admiration.

I am, faithfully yours, JOHN G. BOWMAN.

December 14, 1920.

AMERICAN COLLEGE OF SURGEONS

STATE AND PROVINCIAL CLINICAL SECTIONS

The first annual meeting of the Illinois State Section of the Clinical Congress of the American College of Surgeons was held in Peoria on December 16, 17 and 18.

Surgical clinics were given in the various hospitals by local members of the profession on Friday and Saturday mornings from 8:00 a. m. to 1:00 p. m.

Scientific meetings were held in the Ball Room of the Jefferson Hotel, as follows:

8:00 P. M., THURSDAY, DECEMBER 16

Symposium—Fractures:
- Simple Fractures: New Methods and Apparatus, H. C. Mitchell, M.D., Carbondale
- Compound Fractures: Principles of Treatment, Frederic A. Besley, M.D., Chicago
- Present Status of Open Method of Treatment, William R. Cubbins, M.D., Chicago

2:30 P. M., FRIDAY, DECEMBER 17

Organization for Better Surgery, Franklin H. Martin, M.D., Chicago

Symposium—Ulcer of the Stomach:
- Pathology, Damon Brown, M.D., Peoria
- X-ray Diagnosis, Harry M. McGee, M.D., Peoria
- Medical Treatment, B. W. Sippy, M.D., Chicago
- Perforating Peptic Ulcer, John B. Deaver, M.D., President-elect, American College of Surgeons, Philadelphia

Empyema:
- Surgical Treatment, H. M. Richter, M.D., Chicago, and A. E. Mozingo, M.D., Indianapolis
- Reports and discussion of morning Clinics

2:30 P. M., SATURDAY, DECEMBER 18

Infantile Paralysis:
- Medical Phase, Julius Hess, M.D., Chicago
- Surgical Phase, C. W. East, M.D., State Department of Public Health, Springfield

Plastic Procedures for the Obliteration of Cavities with Non-Collapsible Walls, Allen B. Kanavel, M.D., Chicago

Symposium—Intracranial Infections:
- In Relation to the Eye, Ear, Nose, and Throat, and Accessory Sinuses, R. C. Matheny, M.D., Galesburg
- Diagnosis, John L. Pollock, M.D., Chicago
- Surgical Treatment, Ernest Sachs, M.D., St. Louis.
- Reports and discussion of morning Clinics

8:00 P. M., SATURDAY, DECEMBER 18

Symposium—Uterine Fibroids:
- Indications for Surgery, E. B. Montgomery, M.D., Quincy
- The Advantages of Radiation in Connection with Surgery in the Management of Cancer, William D. Haggard, M.D., Nashville

Symposium—Abortions:
- Cause and Prevention, Thomas J. McKinney, M.D., Champaign
- Treatment of Non-Septic Cases, F. A. Norris, M.D., Jacksonville
- Septic Abortion, Rudolph W. Holmes, M.D., Chicago

The Public Meeting was held at the Central Christian Church at 8:00 o'clock Friday evening, December 17, 1920, the program being as follows:

Dr. Carl E. Black, chairman of the Illinois State Section, presided; Mayor E. N. Woodruff of Peoria delivered the address of welcome; Dr. Franklin H. Martin spoke on the "Organization of the American College of Surgeons"; Dr. John B. Deaver on "How the Layman Can Assist the Surgeon"; Dr. Frederic A. Besley on "How Modern Medicine Can be of Service to the People of Illinois"; and Mr. John G. Bowman on the "Standardization of Hospitals." The closing address was delivered by the Reverend Caspar W. Hiatt.

EXECUTIVE COMMITTEES APPOINTED AND MEETING PLACES SELECTED

The Executive Committees appointed in states in which sectional meetings have recently been held are as follows:

Arizona: Chairman, Winfred Wylie, Phoenix
Secretary, William A. Holt, Globe
Counselor, Roderick D. Kennedy, Globe

The city in which the next annual meeting of the Arizona Section will be held has not yet been determined.

California: Chairman, Stanley Stillman, San Francisco
Secretary, D. C. Strong, San Bernardino
Counselors, Granville MacGowan, Los Angeles
Lewis B. Morton, Los Angeles
H. A. L. Ryfkogel, San Francisco

Los Angeles was selected as the next place of meeting of the California Section.

Utah: Chairman, Frederick Stauffer, Salt Lake City
Secretary, Robert R. Hampton, Salt Lake City
Counselor, John F. Critchlow, Salt Lake City

The second annual session of the Utah Section will be held in Salt Lake City.

Colorado: Chairman, Edward Jackson, Denver
Secretary, Oscar M. Shere, Denver
Counselor, Peter O. Hanford, Colorado Springs

The Executive Committee of Colorado has not yet decided upon the next place of meeting.

New York: Chairman, Russell S. Fowler, Brooklyn
Secretary, Frederick T. Van Beuren, Jr., New York
Counselors, Marshall Clinton, Buffalo
John Osborn Polak, Brooklyn
Edwin MacD. Stanton, Schenectady

The next meeting place of the New York State Section will be announced at a later date.

Illinois: Chairman, Charles H. Brobst, Peoria
Secretary, Frederic A. Besley, Chicago
Counselors, Clarence W. East, Springfield
Edmund B. Montgomery, Quincy
Jonathan L. Wiggins, East St. Louis

The Illinois Executive Committee will later decide upon the place of meeting for this year.

Meetings Scheduled to be Held

Texas—Adolphus Hotel, Dallas, January 7 and 8.

Louisiana—Grunewald Hotel, New Orleans, January 10 and 11.

Georgia—Piedmont Hotel, Atlanta, January 14 and 15.

South Carolina—Hotel Charleston, Charleston. January 17 and 18.

North Carolina—Selwyn Hotel, Charlotte, January 20 and 21.

Arkansas—Little Rock, February 18 and 19.

Oklahoma—Oklahoma City, February 21 and 22.

Iowa—Des Moines, February 28 and March 1.

Nebraska—Omaha, March 3 and 4.

Kansas—Wichita, March 7 and 8.

Missouri—St. Louis, March 10 and 11.

Tennessee—Nashville, March 21 and 22.

Kentucky—Louisville, March 25 and 26.

Ohio—Cleveland, April 1 and 2.

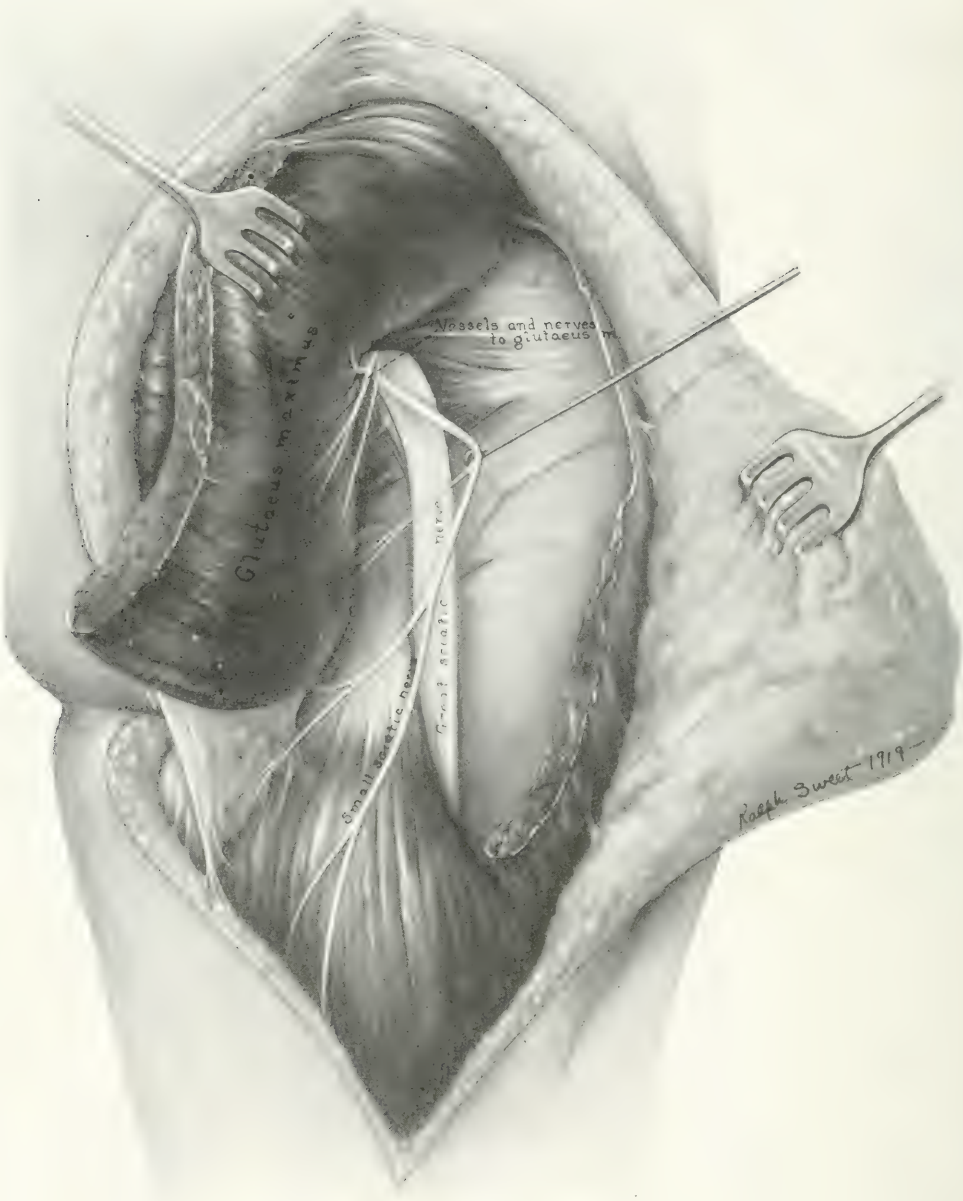


Fig. 5. Sciatic nerve. High exposure.

Methods to Secure End-to-End Suture of Peripheral Nerves.—Howard C. Naffziger

SURGERY, GYNECOLOGY AND OBSTETRICS

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METHODS TO SECURE END-TO-END SUTURE OF PERIPHERAL NERVES

BY HOWARD C. NAFFZIGER, M.D., SAN FRANCISCO, CALIFORNIA

From the Department of Surgery, University of California Hospital

END-TO-END suture of divided peripheral nerves is the aim of the surgeon in those cases of nerve division which come to operation. Cases presenting loss of considerable length of nerve have long been a problem. Endless methods of filling in these gaps have been recommended by surgeons and in large part have resulted in connecting the severed nerve ends by a material not penetrable by the neurones. The experimental works of Huber, Nageotte, and others in the use of free nerve grafts have pointed the way to a more rational treatment. The numerous ill-advised and physiologically unsound but ingenious devices which fill the literature have been replaced by a method having a sound experimental basis.

In our experience, however, and with improvement in operative procedures, the necessity for grafts has become less and less, while end-to-end suture has become more often possible. From the U. S. Army Letterman General Hospital, the neurosurgical service of the University of California Hospital and from other sources, largely industrial, over one hundred cases of peripheral nerve injury have come to operation within the past 18 months. From the large war experiences it would seem that in nerve surgery, the greatest advance has been made in methods of securing end-to-end suture. But comparatively little emphasis has been given to these methods of securing end-to-end suture when the gap is considerable. Increased experience has shown that even after war injuries which in general show a loss of a greater portion of nerve than following civil injuries, only a very small percentage can not be sutured end-to-end. It is of interest to note that in the first 10 cases of this series, two main trunks were considered to have gaps too great for end-to-end suture. In these, "auto cable grafts"[1] were used. In the later cases no grafts for the main nerve trunks were used. End-to-end suture was obtained in all at either a one or two stage operation. In addition, one of the earlier grafted cases was again operated upon, the graft removed and end-to-end suture obtained. We believe that auto nerve grafts, homo grafts, or hetero grafts should be reserved for those cases in which all methods of securing the direct suture have been exhausted. Apparently it is not an uncommon procedure for surgeons to resect bones of the extremities to secure shortening in order that they may obtain end-to-end suture. We feel that conditions justifying this must be most rare. In lesions of the large nerve trunks of the extremities—the ulnar, median, musculospiral, the great sciatic and its internal and external popliteal divisions, it is rare that end-to-end suture cannot be obtained. The vast majority of nerve wounds involve these trunks rather than their smaller sub-

[1] "Cable graft" is applied to free nerve grafts when several strands of nerve are used.

divisions. It is our feeling that free nerve grafting from the same individual is the most rational method of filling unbridgeable gaps but that resort to it should be made only after all methods of obtaining end-to-end suture have proved ineffectual.

Of the methods we have found most useful in obtaining apposition of the divided nerve ends are:

1. Free mobilization of the proximal and distal portions of the nerve.
2. Transposition of the nerve to a shorter route than the normal one.
3. Favorable posture of the extremity to shorten the distance to be overcome.
4. Gradual lengthening of the nerve by a two-stage operation.

FREE MOBILIZATION OF THE PROXIMAL AND DISTAL PORTIONS OF THE NERVE

Free mobilization of the nerve requires above all, long incisions. Small incisions and forcible stretching of the nerve produces unnecessary trauma and does not secure the greatest lengthening. The attachments of the nerve sheath to surrounding fascia will not be freed by pulling. It is often found that free mobility is prevented by small nerve branches to muscles. Careful exposure of these and gentle dissection of them for some distance up the nerve trunk will be necessary before the desired freedom of movement is obtained. To secure the requisite mobility of nerve trunks, the exposure frequently must include great lengths. For the musculospiral nerve this may require an incision from the middle of the outer side of the arm down the upper forearm, with a second incision on the inner side of the arm exposing the nerve in its upper third and well up into the axilla. To free the ulnar nerve properly, even longer incisions over the course of the nerve may be required. For lesions of the great sciatic in the thigh or its branches in the popliteal space an incision from the gluteal fold to the knee is the rule rather than the exception. The long incision has additional advantages in obtaining greater delicacy of handling and permitting easier orientation when dealing with massive scars and distortion of normal anatomical relations. Wide dissection of the deep fascia from underlying muscle is most helpful in locating the lines of cleavage along intermuscular planes and in securing land marks. Varying the tension on muscle by flexion of the neighboring joints may facilitate dissection from nerve or scar and aid retraction. Recognition of small muscular branches is aided and careless sacrifices of them prevented. In dealing with large cicatrices much time may be lost in a search for the nerve if it is approached directly. A long incision—identification of the distal and proximal portions of the nerve in their normal relations above and below the scar—is the first step. After this a knowledge of the branches normally between these points will permit of more careful and rapid dissection of the scar without a division of intact branches or of the main trunk itself. After freeing the involved area, the condition of the nerve will determine the further operative procedure. When suture is to be performed and mobilization of the nerve is desired, gentle traction on the scarred ends will show the points of attachment of the nerve sheath which can then be freed by sharp dissection. Frequently short muscular branches will hamper the movement of the main trunk. With a fine, very sharp scalpel and slight traction, the line of cleavage at the junction of the branch with the nerve trunk can be followed for considerable distances without difficulty. This procedure does not cause even temporary interference in the function of these branches. This may be shown on the day following operation by voluntary power in the muscles supplied. It has frequently been observed after lesions of the ulnar nerve below the branches to the flexor carpi ulnaris and the inner heads of the flexor profundus digitorum. The day following the dissection unimpaired power in these muscles can be shown. The lack of interference with function is also seen in lesions of the lower sciatic after its branches to the hamstrings have been dissected up. Freeing of the fascial attachments of the nerve sheath from its bed and this method of lengthening muscular branches is completed for both the proximal and distal portions of the nerve. It is unwise at this stage completely to resect the scar tissue at the point of injury. By dis-

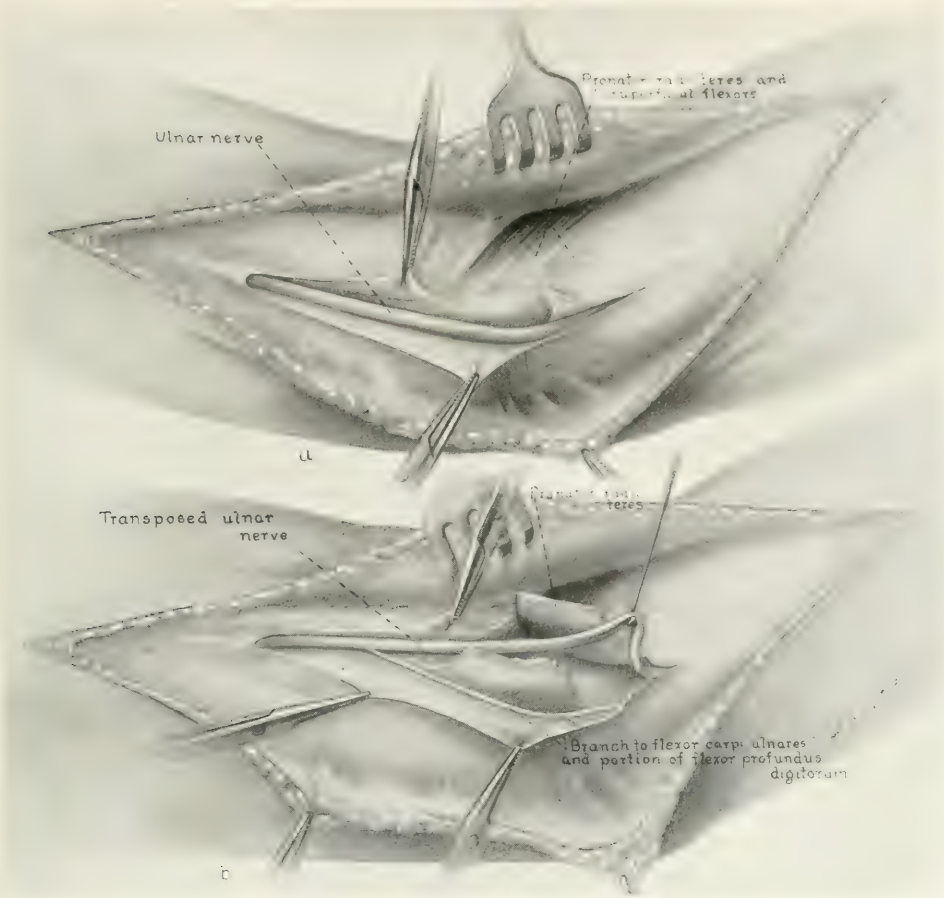

Fig. 1. Ulnar nerve. *a*. Normal route; *b*, transposed route.

section of surrounding scar from parts of the nerve trunk not invaded, by electrical stimulation, and by incision into the scar, one may supplement the information previously gained from clinical examinations and obtain an idea of the amount of resection necessary. With complete anatomical and physiological interruption one may judge the approximate length of the gap to be overcome.

TRANSPOSITION OF THE NERVE TO A SHORTER ROUTE THAN THE NORMAL ONE

Ulnar nerve. In the case of the ulnar nerve, no branches are given off in the arm. About 2½ or 3 inches above the internal condyle of the humerus, the ulnar nerve perforates the internal intermuscular septum and comes to lie behind it. It then passes downward behind the condyle, in the ulnar groove. Just below the condyle its branches to the flexor carpi ulnaris and the inner heads of the flexor profundus digitorum are given off. There are no further branches until about the middle of the forearm where a small branch passes to the ulnar artery. Below this and about two inches above the styloid process of the ulna, the dorsal cutaneous branch is given off. By transplanting the ulnar nerve at the elbow from behind the condyle to the flexor surface in the bend of the elbow, the route is slightly shortened and a gain is made. It should be noted that to secure the greatest mobility, it is necessary to extend the incision sufficiently far to free the nerve well above and at the point where it pierces the internal intermuscular septum. In cases of ulnar paralysis we do

not feel it is justifiable to sacrifice the branches to the long flexors when transposing the nerve. It is possible and not difficult with a small, sharp knife to dissect these branches away from the main trunk for a considerable distance. By placing the nerve under slight tension one can follow the line of cleavage of the fibers. The muscle branches are then of sufficient length to follow the normal anatomical route of the ulnar nerve, even though the main trunk is placed in front of the condyle. It has seemed more satisfactory in changing the position of the ulnar nerve to place it beneath a covering of the deep fascia and muscles and to give it an absolutely straight route. After dissection of the superficial fascia away from the deep fascia, the upper margin of the pronator radii teres is identified. With a small incision along its upper margin close to the internal condyle, it is possible to elevate it slightly and locate the plane upon which the ulnar nerve is to lie. The superficial flexors and the pronator are cut through close to their origin at the internal condyle and reflected (Fig. 1, *a* and *b*).

There is no natural line of cleavage between these muscles and the deep flexors. An incision through the deep fascia and the superficial muscles will permit them to be split back a few centimeters from their origin. This separation requires a short incision in the intermuscular aponeurotic fascia. The branches of the median nerve to the pronator are on the inner side and are not jeopardized. The ulnar nerve is placed beneath the reflected muscles which are then sutured in place. The deep fascia from above the site of former perforation of the internal intermuscular septum is then sutured over the nerve. A more simple procedure is to transplant the ulnar nerve to a position in front of the condyle but not to bring it beneath the deep fascia and muscles. In such a position, however, it can be felt close beneath the skin and is not infrequently tender. Another method is to cut only the attachment of the long ulnar flexors. Our results following transposition beneath the muscles have been entirely satisfactory. On the following day with lesions distal to these branches, voluntary power in the long flexors supplied by the ulnar nerve can be readily demonstrated, showing that the dissection of the muscle branches from the main nerve trunk has in no way interfered with their function.

Musculospiral nerve (Fig. 2, *a* and *b*). Lesions of the musculospiral nerve are frequent and the results have excited frequent comment as perhaps being better with lesions of this than with lesions of the other peripheral nerves. The nerve is more commonly injured in the lower half of the arm than in the upper. Fortunately, with lesions of the musculospiral much can be gained by altering the position of the arm and gaps which often times at first sight might seem impossible to lessen sufficiently for an end-to-end suture can be overcome. In certain instances, transposition of the nerve to a position in front of the humerus is desirable and is particularly applicable to those cases in which there has been an extensive injury to the posterior surface of the arm with a large amount of scar involving the triceps and the posterior surface of the humerus. The transposition, however, can be used when the injury is at other locations. For the transposition two incisions are necessary. In the lower half of the arm the nerve is exposed by an incision on the outer side, extending downward in the bend of the elbow to the mesial side of the external condyle. The second incision is made over the brachial sheath in the upper half of the arm on the inner side. With an external incision alone it is impossible to bridge very considerable gaps by dissecting the nerve free and mobilizing it down to its terminal branches in the forearm. The branch to the supinator longus is not sacrificed, but may be dissected up for a short distance. Through the external incision it is possible to follow the lower half of the nerve well up along the musculospiral groove and mobilize it. This procedure permits of a surprising amount of gain. A second incision may be made over the brachial sheath in the upper third of the arm. The musculospiral is exposed at the lower margin of the teres major where it passes behind the humerus and between it and the long head of the triceps (Fig. 3, *a* and *b*).

The long branches of the musculospiral to the triceps are in full view and if necessary can

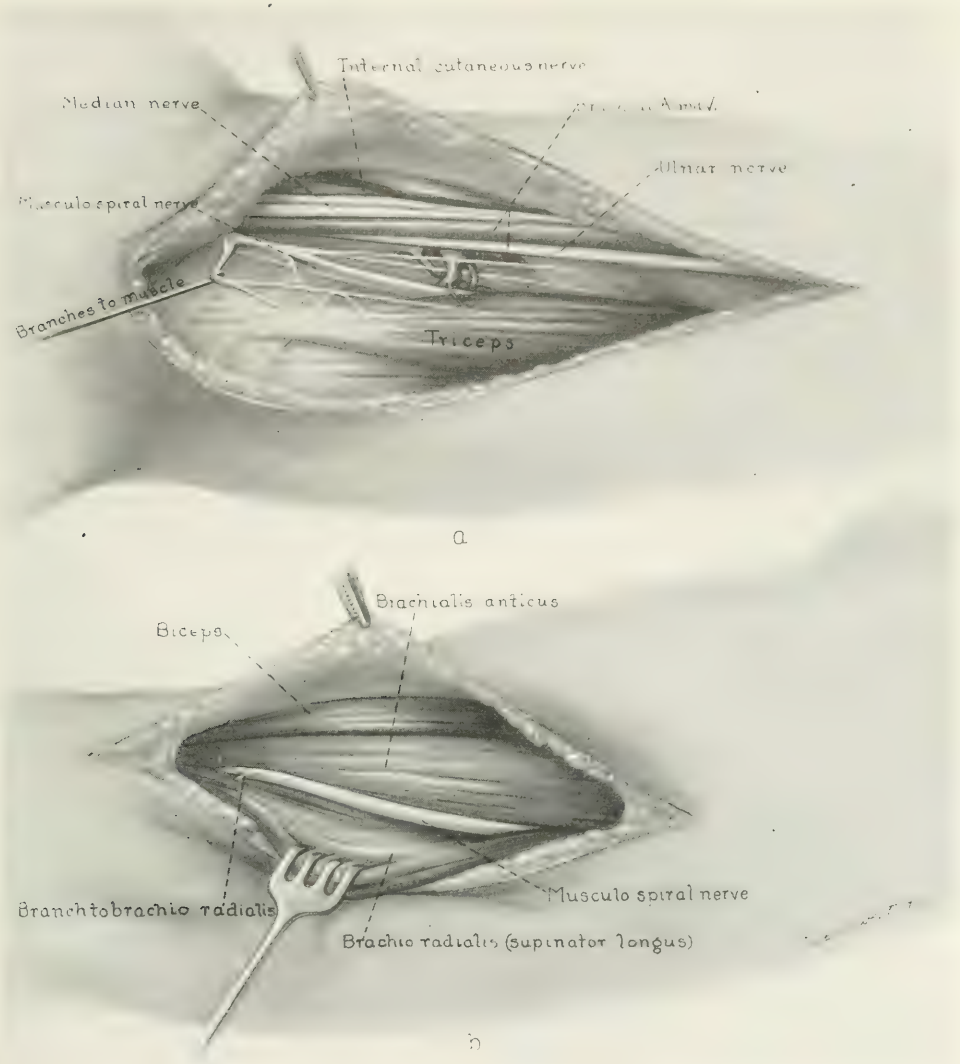

Fig. 2. Musculospiral nerve. *a*, Normal relations in lower axilla; *b*, normal relations in lower arm.

be dissected up for some distance along the course of the nerve. The nerve is then brought out of the musculospiral groove and is passed behind and to the outer side of the axillary vessels and the median and ulnar nerves. The biceps is then dissected free so that an oblique position of the musculospiral is permitted beneath it. The nerve then runs directly from the axilla in front of the humerus, lying beneath the biceps and emerging about 2½ inches above the lower end of the humerus on the outer side. The branches to the outer head of the triceps are sacrificed. Such a transposition does not give a great gain but it does permit of a slight one and in addition the arm can also be placed in a more favorable position to make a gain from adduction, flexion, and internal rotation at the shoulder with flexion at the elbow.

Median nerve. The median nerve takes a more direct course than either the ulnar or musculospiral nerve. Some lengthening may

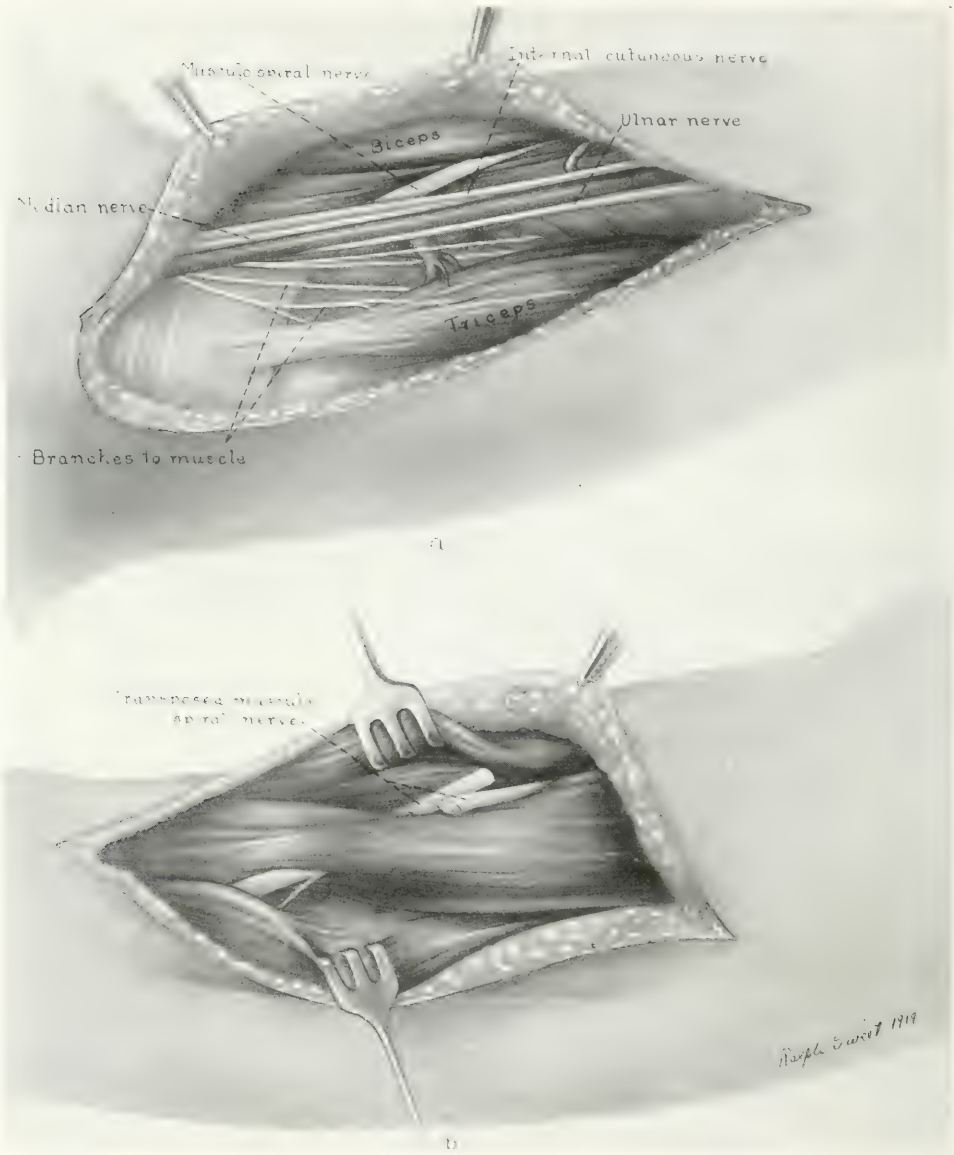

Fig. 3. Musculospiral nerve. *a*, Transposed route, upper arm; *b*, transposed route, lower arm.

be obtained by dissection upward of the muscular branches in the upper forearm and transposition to a more superficial position.

Sciatic and internal and external popliteal nerves. In the lower extremity the course of the sciatic is such that a shorter course can not be obtained by transposition. This also applies to the two subdivisions of the sciatic.

FAVORABLE POSTURE OF THE EXTREMITY TO SHORTEN THE DISTANCE TO BE OVERCOME

It is fortunate that the main nerve trunks in the extremities lie for the most part on the protected flexor surfaces. When this is not the normal position of the nerve throughout its entire course as in the musculospiral and ulnar nerve this favorable location can be

obtained by transposition. Owing to this favorable circumstance, flexion of certain joints will relax the nerves and while in a position of flexion the distance bridged by the nerve will be shortened. An otherwise unbridgeable gap may be overcome and sutured end-to-end by flexion of neighboring joints.

Ulnar nerve. With the ulnar nerve the advantage from flexion at the elbow is obtained only after transferring the nerve from behind the internal condyle to an anterior position. An additional gain below is made by flexion of the wrist. This is particularly useful in lesions low in the forearm and hand. With lesions above the branches to the long ulnar flexors, flexion of the wrist is of little value, for while it relaxes the main ulnar trunk, these muscular branches restrict its movement above. Unless these are sacrificed, flexion of the wrist is of little value fors uch lesions. With the high injuries, flexion of the elbow and adduction of the arm to the side give the greatest gains. With high mobilization in the axilla, adduction and a forward position of the arm with full flexion at the elbow are used. It should be remembered that the usual position of the arm at right angles to the body and extended as during operation is an unfavorable one for suture.

Musculospiral nerve. With the musculospiral nerve free mobilization is of the utmost importance and next comes flexion of the elbow with the forearm in pronation. Some gain is made by adduction of the arm to the side. Carrying the elbow well forward on the chest still further shortens the distance from the axilla to the elbow. The greatest gain in lesions of the musculospiral has been obtained by extensive mobilization through both the inner and outer incisions, transpositions of the nerve to the front of the humerus followed by full flexion at the elbow with easy pronation of the hand. Also the elbow is carried well in front of the chest and elevated, with the upper arm in internal rotation and the forearm resting on the chest.

Median nerve. With the median nerve, the same postures are used. Wrist flexion in low lesions, elbow flexion, adduction of the arm, a forward position of the elbow and elevation of it for higher injuries.

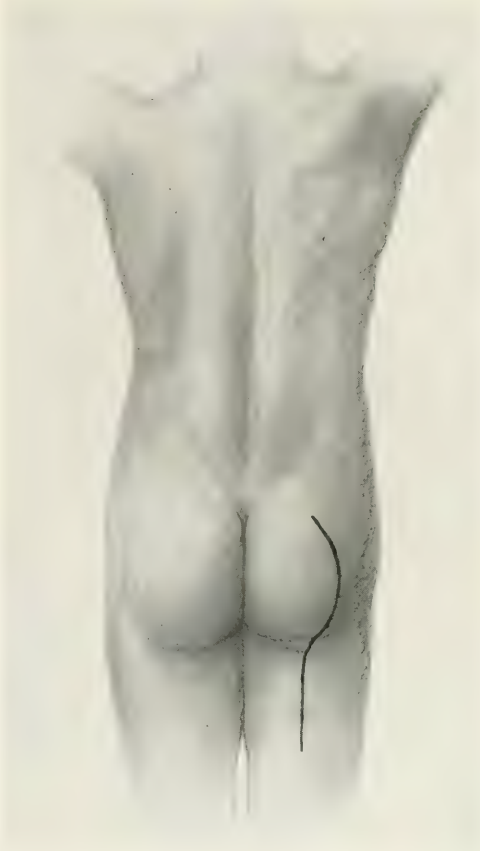

Fig. 4. Line of incision for high exposure of sciatic nerve.

Sciatic nerve. The sciatic nerve gaps are slightly lessened by full extension at the hip and a position mid-way between adduction and abduction but the great gain is obtained by full flexion of the knee. The same positions are most favorable in overcoming gaps in either the internal or external divisions of this nerve. For high lesions of the great sciatic the following procedure has appeared to us most satisfactory; it gives complete exposure up to and well into the sciatic notch. No nerves or other important structures are cut. On the posterior surface of the thigh, a mid-line incision is made over the course of the nerve. The upper end of it lies at the gluteal fold, mid-way between the ischial tuberosity and the great trochanter of the femur. The portion of the incision over the buttocks is convex outward, the lower end

meeting the upper end of the straight incision (Fig. 4). The superficial fascia and skin are dissected well back to the trochanter on the outer side and the gluteus maximus is cut at its insertion or separated subperiosteally. The muscle is then reflected toward the midline and the entire course of the sciatic nerve from the pelvis is uncovered. The margins of the sciatic notch are exposed. With this exposure we have been able to perform suture in intrapelvic division of the nerve, about 2 centimeters inside the sciatic notch. The vessels to the gluteus maximus as well as its nerve supply reflect with the muscle to the median side (Fig. 5). At the close of the operation the muscle is accurately sutured in place with a few chromic gut sutures and also the pyriformis if it has been cut. There is no interference to the return of function in the gluteus maximus. For the suture of the sciatic in the thigh and likewise for the internal and external popliteal nerves, free mobilization down to the terminal branches of the main trunks is obtained. Following this, full flexion of the knee usually permits the suture to be made.

GRADUAL LENGTHENING OF THE NERVE BY A TWO-STAGE OPERATION

In a small number of cases in which an end-to-end suture can not be obtained at a one stage operation it has been in our experience a more satisfactory procedure to do a second stage operation rather than to resort at once to a nerve graft. After using all the means at our command if it is obvious that after complete resection of the neuromata and the scar, end-to-end suture can not be obtained the following plan has been adopted. The fibrous ends of the proximal and distal nerves are overlapped as far as possible taking advantage of all gains from favoring posture. The fibrous ends are not resected but sutured firmly together in this overlapped position and the wound is closed. The posture of the extremity is maintained by cast or splints; later, gradual extension of the part is permitted until there is normal freedom of movement and the normal range of motion is acquired. At the second stage operation which is usually not performed before 2 months after the first, the suture is accomplished. The scarred portion is resected. The part is again put in a favoring posture and end-to-end suture performed as in a one stage operation (Fig. 6, *d*).

The question arises as to the result on the nerve of this lengthening process following the first stage operation. At the second stage it is found that the nerve above and below the lesion shows some attenuation and some decrease in the size of the bundles above and below. Upon section, however, the nerve is vascular and the final test is in the regeneration. In nerves sutured in two stages satisfactory regeneration has occurred. Our results have been much better than after auto cable grafts.

NERVE SUTURE

Many technical details have been emphasized with regard to the exact method of nerve suture. The essentials are delicacy of handling and the avoidance of trauma, accurate suturing without tension, with the use of a minimum amount of foreign material to favor the production of fibrous tissue, and the proper protection of the parts afterward. In recent years much has been written as to the details of arrangement of nerve bundles in the various nerves, and we consider it of importance to avoid any rotation of the nerve during suture. It is recognized in the detailed anatomy of nerves that certain bundles occupy a definite, fixed, and fairly constant position in the nerve. If in suturing a divided nerve, it is rotated, it may be that bundles of sensory nerves are approximated to motor tracts in the distal portion. Even in the event of regeneration in such a case as this, motor neurons from the proximal segment could not be expected to supply fibers to the tract below. Likewise, sensory neurons above could not be expected to supply the stimulus necessary for muscular contraction. When the musculospiral nerve, which contains few sensory fibers, is sutured even if it is rotated, most of the motor neurons will still be in contact with motor tracts. There are fewer opportunities, then, for them to go astray. This may explain the fact that better results are secured after suture of the musculospiral nerve than

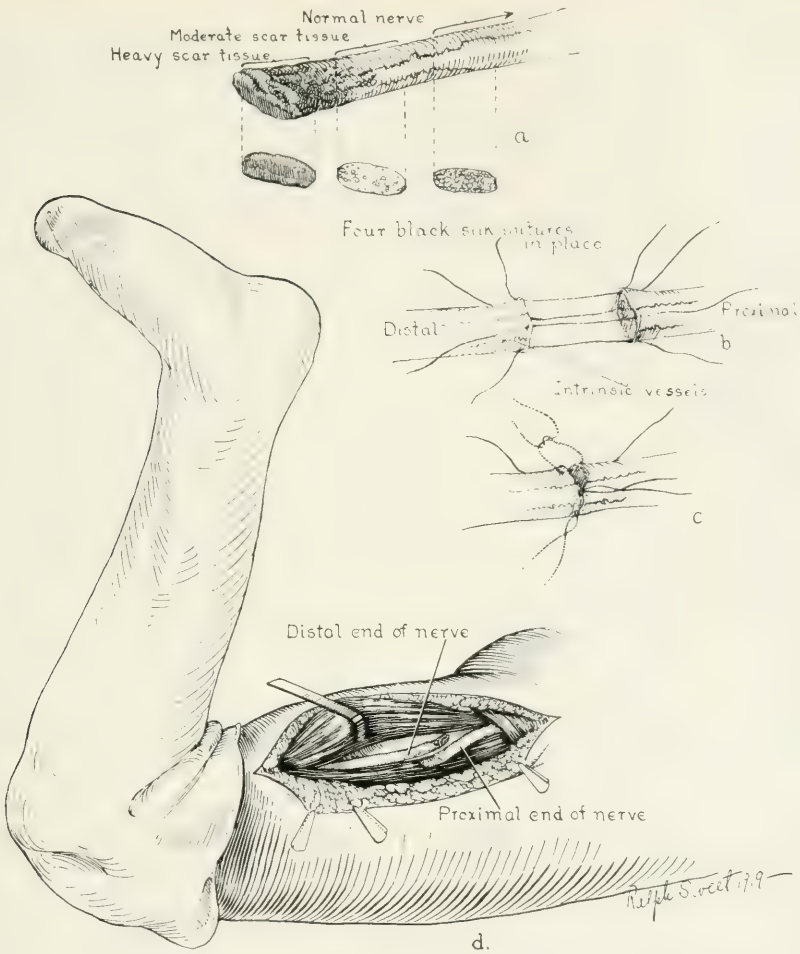

Fig. 6. Sciatic nerve. *a*, Sections of neuroma; *b*, sutures in place; *c*, Sutures tied; *d*, gap overcome by knee flexion.

after the suture of other nerves. With this idea in mind, we have endeavored in suturing nerves to avoid rotation. The nerves are found frequently rotated in the scar tissue to which they are attached. It may be very difficult to determine their correct position but by careful attention to vessels of the nerve, it may be possible to match them with a fair degree of accuracy. Many of the complicated details of nerve suture seem to defeat their object by favoring the production of an increased amount of fibrous tissue. In the exposure and handling of the nerve, freedom from trauma is obtained by exposure of the nerve well above and below the site of lesion. Delicate handling of the nerve is of first importance and compression or traction are to be avoided. When handling is necessary the sheath only should be grasped. While the proximal and distal portions of the nerve are still lying in place, close observation may enable one to match vessels of the proximal and distal portions. Prior to resection of the neuroma, it is well to have landmarks to guide one in a later suture. Fine silk sutures can be used as markers. A small amount of nerve sheath can be picked up in this way. In introducing the needle into the sheath, the suture should be placed in the long axis of the nerve and not transversely on account of the

lessened risk of injury to the fibers. The neuroma is sectioned serially with a sharp knife, beginning at its most dense portion. Each successive section is closer to normal nerve. It should be unnecessary to state that scissors should not be used in cutting nerve tissue on account of the crushing involved. Upon sectioning through dense scar, the tissue is dead-white, very fibrous, and shows no cut nerves and bleeds little or none at all. As successive sections are made it becomes more vascular and occasionally a small, rather white cut end of a nerve is seen. These increase as normal nerve is approached. It is usually not difficult to determine when we have reached a nerve that is entirely free from fibrous tissue (Fig. 6, *a*). On the proximal side of the injury such a nerve presents a succulent, rather œdematous appearance; the ends of the nerve bundles protrude slightly and are soft in appearance and the nerve bleeds freely, usually showing a spurting artery. Sponging of the cut nerve ends is to be avoided; for this purpose, when necessary, cotton satured with warm Ringer's solution should be used. It is preferable to permit such a vessel to bleed until clotting occurs rather than to attempt sponging or clamping. To clamp a vessel in the substance of a nerve and tie it, only adds to fibrous tissue production. When bleeding has stopped, any adherent clot is readily removed by a small amount of Ringer's solution and a cotton sponge. Regarding the distal portion of the nerve, its appearance is quite different from the proximal. It is much smaller, both in its total bulk and in the size of the nerve bundles. Serial sections are made in the same way until normal distal nerve is reached. It is whiter than nerve above the lesion and the bundles are smaller and firmer. Although it bleeds freely, the vessels are neither as numerous nor as large as in the proximal portion. It must be handled in the same gentle way as the upper segment. The guy sutures previously placed give us our landmarks, so that we may avoid rotation. A few fine silk sutures are then placed, usually four in number. These sutures take in only the sheath of the proximal and distal portions (Fig. 6, *b*). We have preferred simple sutures, as less tissue is strangulated when they are tied. No detail which will lessen the scar production is insignificant. After these sutures are placed, the limb is brought into a favorable position for approximation and the sutures are tied (Fig. 6, *c*). It should be noted that a tight suture which includes too much of the sheath will bring the cut nerve ends too close together and cause them to be forced outward as a brush. The nerve bundles should barely come in contact. They should not be brought tightly together. The last remnants of any clot present are removed just before tying the sutures. The sutures used are of the finest silk. If the approximation of the sheath is not exact, additional sutures may be placed. Even with a nerve as large as the sciatic, more than seven or eight sutures are seldom required. Sutures are not to be relied upon to stand any great tension. Proper mobilization of the nerve should permit one to estimate the amount of the tension there will be. If the ends of the nerve can not be readily brought together and held with the lightest suture, accurate approximation can not be obtained. It has been remarkable to note that after a suture has been made with joints in the most favorable posture some lengthening of the nerve occurs rapidly. The joints will rarely need to be splinted in the extreme position in which they are held during the suture. It has happened in two instances that extremities have been straightened within 24 hours following suture. In neither of these did the nerve ends pull apart. Such a procedure is not to be recommended, but it throws some light on the possibilities of the gradual lengthening of nerves.

PROTECTION OF THE SUTURE LINE

The literature has been filled with various devices for protecting the line of nerve suture against the invasion of fibrous tissue. Foreign materials have in general opinion been less desirable than an auto graft of fat or fascia. We have considered that any foreign material or any free graft favors the production of fibrous tissue. Transplanted fat becomes fibrous. We feel that the most desirable bed for a line of nerve suture is against the uninjured muscle and preferably between muscle planes. Upon re-exposure of a nerve in which the line

of suture has been so placed, the condition has been most satisfactory. A free dissection of scar tissue at the time of operation and the covering over of raw surfaces has been practiced. Even pedicled flaps of fat, fascia, or muscle may cause some scar contraction. A recent case gave a history of a tender ulnar nerve at the internal condyle with impaired use of the hand. Two years before, after a slight blow and with no bone injury, his ulnar nerve had been found to dislocate readily. It was operated upon and fastened in place by surrounding it with a pedicled flap of deep fascia. When coming to us the function of the nerve was impaired about 50 per cent and the ulnar area was anæsthetic. At operation the fibrous investment was found to have constricted the nerve and was too firmly attached to it to permit of its complete removal. A neurolysis and transposition of the nerve was done. Such results make one chary of the degree of protection offered by partially vascularized or avascular tissue. Under the impression that it is of some value we have used heat and gentle massage of the operative wounds over the site of nerve suture soon after wound healing has occurred.

More complicated intraneural methods of suture have their advocates, but are apt to defeat their object. Many prefer at least one through-and-through suture of catgut. This may be advisable in exceptional cases but we have felt that equally good approximation and less trauma was produced by careful suturing of the neurilemma only. Freedom from tension and avoidance of those factors which increase scar-tissue production and neuroma formation are the essentials.

AFTER-TREATMENT

The length of time in which a favoring posture of the extremity must be maintained after nerve suture varies widely in the opinion of various surgeons. Of necessity it varies with the length of the nerve gap overcome and the degree of tension. The period should be considerably longer after a two-stage operation than after a single stage operation. There are other factors to be considered. Certain alterations in the position of a joint are of less importance than others. In the lower extremity the position of the hip whether in abduction or adduction is of less importance than to prevent flexion at the hip or extension at the knee. In the upper extremity the forward position of the elbow on the chest is less important than the maintenance of flexion of the elbow. Likewise certain cases will demand less extreme joint positions. With the sciatic nerve and its divisions only partial flexion at the knee may be necessary. While the importance of certain elements in the posture of the parts varies, it has been our custom to maintain the position found necessary at operation for a period of 5 or 6 weeks. After this time gradual adjustments are permitted and about 1 month more is consumed before full range of movement is permitted. Considerable latitude must be allowed depending upon the requirements of the particular case. Immediately following operation a plaster-of-Paris spica for the lower extremity has been found most satisfactory to maintain extension and moderate abduction at the hip flexion at the knee and to support the foot. If the knee is not in a position of full flexion, the posterior portion of the cast is, in a few days, removed from the mid-thigh to the foot. This permits of massage and a change in the degree of flexion at the knee obviating joint stiffness and further atrophies. After daily massage and movement, the leg and foot are re-bandaged to the shell of the cast. With the upper extremity, plaster of Paris has been used only to maintain full flexion at the wrist. For preserving the correct attitude at the elbow and shoulder, soft dressings and starch bandages have been efficient and comfortable. They are applied in some such fashion as the Velpeau bandage. Movements of the joints within the permitted range and massage are continued until the normal position of the part is resumed and are continued with all other aids during the entire period of nerve regeneration. Casts or splints not readily removable are avoided as favoring atrophies and joint stiffness.

LENGTH OF NERVE GAPS

Injuries of the main nerve trunks of the upper and lower extremities are more frequent than injuries of their subdivisions. With rare

exceptions, the repair of them can be made by end-to-end suture. A much smaller number of peripheral nerve injuries occur to the subdivisions of the main trunks. Often in association with these are extensive injuries to muscles and tendons and consequently large scars. With the smaller nerves similar methods of operative procedure usually permit of nerve suture. The proportion, however, which will require nerve grafts is larger than with injuries of the main trunks, for less gain can be made by mobilization, transposition, and posture. By the use of nerve grafts from the same individual, we have secured regeneration through a graft 10 centimeters in length with consequent improvement in sensation and a return of voluntary power in the muscles supplied. This return of voluntary power, however, while permitting of a considerable range of movement, was quantitatively too weak to be called a satisfactory functional result. In this particular case after the better development of our methods, we were able to excise this graft and secure end-to-end suture.

We recognize and appreciate the value of the nerve graft in cases where end-to-end suture can not be obtained. Such cases, however, are in small proportion and resort to graft should be made only after all attempts at end-to-end suture have been unsuccessful.

From operative experiences and from anatomical studies and measurements, we consider the following figures represent an average of the distances which may be bridged.

For the ulnar nerve, mobilization alone permits of suture after a 3 centimeter gap; after mobilization and transposition 4.5 centimeters. Adduction of the arm to the side permits a slight additional gain; with mobilization, transposition, adduction, and complete flexion of elbow and wrist, 10 centimeters.

For the musculospiral nerve, mobilization alone permits 2 centimeters; mobilization with elbow flexion, 8 centimeters; with mobilization, elbow flexion and adduction, slightly more, usually about 8.5 centimeters; mobilization, transposition, elbow flexion and adduction, 10 centimeters.

For the median nerve, mobilization 2 centimeters; mobilization, adduction and elbow flexion, 9 centimeters.

For the sciatic nerve, and the internal and external popliteal trunks, mobilization 3 centimeters, mobilization, extension at the hip and flexion at the knee 9.5 to 10 centimeters.

These figures represent distances which may be bridged at one stage operations. With two stage performances, additional gains may be made.

A large number of our cases of nerve division have received their injuries in war. The difficulties of securing end-to-end suture are greater than after the injuries in civil life owing to the more extensive loss of tissue. In certain cases we feel that free nerve grafts offer the best prospect of a satisfactory result. In others as after the loss of many small muscular branches or with extensive muscle and tendon injuries, tendon transplantation, arthrodesis or some permanent splint should be considered. Fortunately it is not often that resort to these must be made. End-to-end suture is the method of choice and with few exceptions can be obtained. This is particularly true of the main nerve trunks. Familiarity with these methods in peripheral nerve surgery gives an increasingly high proportion of end-to-end suture.

CHEMICAL INFLUENCE OF THE ACTIVE CONSTITUENTS OF THE DUCTLESS GLANDS[1]

By E. C. KENDALL, Ph.D., Rochester, Minnesota
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EACH ductless gland elaborates one or more definite chemical substances which is contained within its specific secretion. In order to understand the chemical processes resulting from the activity of the ductless glands, it is the duty of the chemist first to separate and then to identify each of the definite chemical substances which are produced by the various glands. So far the chemical investigation of the glands has resulted in the isolation of only two of the active constituents.

The active constituent of the adrenal medulla was investigated in 1901 by three chemists, Abel, Takamine, and Aldrich. Abel separated the benzoyl derivative of a substance which he named epinephrin, meaning the active constituent of the adrenal. Due to the work of Takamine, epinephrin, or adrenalin, as he named it, was made commercially available. Epinephrin is a distinctly crystalline substance, which possesses a definite chemical composition and its exact nature is so well known that it has been synthesized from simple organic chemicals and can be prepared at a moderate cost. Epinephrin can be prepared from the gland in a very simple manner. The proteins of the gland are first coagulated by boiling in dilute acid. The epinephrin is left as a soluble salt in the water and all the proteins are precipitated. The solution is concentrated and the epinephrin is precipitated in crystalline form by the addition of ammonia.

The second gland the secretion of which has been identified by the chemist is the thyroid. The thyroid has long been known to contain iodine. In 1914, I separated the iodine-containing compound of the thyroid in pure crystalline form (3). Since that time its identification has been accomplished and a great deal of work has been carried out in our laboratories concerning the exact chemical properties of this compound, which has been named thyroxin (4, 5).

Thyroxin is a white crystalline substance which has the properties of a very weak acid. It is extremely insoluble in water, about one part in one million parts of water, but it is readily soluble in sodium hydroxid. The most striking characteristic of thyroxin is its iodine content. The substance contains 65 per cent of iodine, which is very firmly attached to the organic nucleus and is not easily broken off with sodium hydroxid, although it is very easily broken off by the action of sunlight.

The preparation of thyroxin from the thyroid gland is much more difficult than the separation of epinephrin from the adrenal. Thyroxin is combined as an integral part of the protein molecule and before any attempt at separation can be carried out it must first be liberated. This is accomplished by boiling the entire gland in 5 per cent sodium hydroxid. The proteins are destroyed and when acid is added practically everything is held in solution except the thyroxin. Thyroxin is extremely insoluble in acids and the first impure precipitation with acid contains approximately 10 per cent of iodine, although the original fresh gland contains only 0.04 per cent, that is, the thyroxin is 250 times more concentrated in this precipitate than it is in the gland. Although this step is simple, to prepare pure crystalline thyroxin from the first impure precipitation is not an easy matter. However, it may be accomplished with a fair yield by taking advantage of the insolubility of thyroxin in alcohol, and the fact that the impurities form salts with barium.

Although the active constituent of the posterior lobe of the pituitary has not been isolated, in some respects its action resembles that of histamine. This resemblance is not a proof of the identity of the substance, and the exact nature of this portion of the pituitary is unknown. The anterior lobe of the pituitary appears to be related to the phenomenon of growth. Robertson has separated a mixture of substances which he claims affects the

[1] Presented before the Clinical Congress of the American College of Surgeons, Montreal, October, 1920.

growth of small animals, but he has not carried this investigation to completion.

The active constituents of the other ductless glands are known only through the effects they produce when administered to normal animals or by the effects following their extirpation, and it is mere speculation to ascribe to these glands any action which can be expressed in chemical terms. Chemically they are unknown substances.

The feeding experiments with the other ductless glands have led to interesting results which find some application in clinical medicine. Definite progress will not result from "shotgun" administration of varying mixtures of these glands, but will come only after the actual isolation and identification of the active constituents of each one.

Although the exact chemical structure of epinephrin has been known for about 18 years, this knowledge has not directly assisted in an explanation of the chemical reactions which follow its administration. Just why this particular configuration should be physiologically active is unknown. That the activity is dependent on the precise arrangement of the groups within the molecule is proved by the preparation of the optical isomer of epinephrin.

During the course of the synthetic preparation of epinephrin equal amounts of so-called right-handed and left-handed epinephrin are produced. Only the left-handed form is found in the body, and although the two compounds have the same chemical composition, they do not show equal physiological activities. The left-handed form possesses fifteen times the physiological activity of the right-handed. It is therefore necessary to separate the two forms. This can be accomplished readily, and it is then found that the left-handed form possesses identical physiological activity with the natural substance. It would appear that this specific chemical structure of epinephrin fits some chemical mechanism within the body as a key fits a lock. Any deviation from the exact configuration destroys its effect.

When epinephrin is administered a long series of results follows. Apparently all physiological processes are altered. Some of the most obvious effects are on the blood pressure, the distribution of blood within the body, change in the rate of flow of blood through certain organs, the production of glycosuria, and a rise in the metabolic rate. The effect also varies with the dosage, a large amount producing in some cases the direct opposite of a small amount. The most characteristic action of epinephrin, however, is the immediate response to its administration and the very short duration of its action.

The active constituent of the thyroid has been known clinically for about 25 years and its effect on cretinism and myxœdema has been almost miraculous from the very first clinical application. Any substance supposed to be the active constituent of the thyroid must do all that desiccated thyroid will do. It may be stated in brief that thyroxin will bring about all the changes in the thyroid-deficient individual that are brought about by desiccated thyroid. Physiologically it has almost numberless effects. As with epinephrin, there seems to be no physiological process which is not influenced after injection of thyroxin.

For 19 years the only known chemical difference between the thyroid and the other glands of the body was the presence of iodine. For this reason all attempts to explain its physiological nature were based on our knowledge of what iodine and iodine-containing compounds will do. The isolation of the organic nucleus to which the iodine is attached of course simplifies the problem, but in another way it raises still more questions. That is to say, is it the idodine in the molecule or the organic nucleus which is responsible for the activity of thyroxin? This question can be answered only through the synthetic preparation of thyroxin, replacing the iodine with other groups, especially hydrogen, and the determination of the physiological activity of these compounds. Some of these substances have been prepared in our laboratories, but I cannot at this time report on their physiological significance.

Unless single, pure chemical substances are used the investigation of the chemical influence of the adrenal and thyroid is hopeless. This is illustrated by the large amount of work which has been done concerning the effect of the thyroid on the blood pressure. Some in-

vestigators have found that the blood pressure is increased by intravenous injection of extracts of the thyroid; others have found that it is decreased; and still others have found that it is not affected. When this experiment is tried with pure cyrstalline thyroxin it is found that there is no effect on the blood pressure and there is no marked physiological response immediately following the injection in a normal animal. The response does not begin until after several hours. Plummer has shown that the maximum effect is reached about the tenth day in the myxœdematous patient and that the definite physiological effect of a single injection of thyroxin is continued for at least 24 days.

The determination of the time relations of thyroxin illustrates how difficult it is to establish proper clinical use for an unknown substance such as desiccated thyroid. Since the amount given on any one day requires about 10 days to build up its full response, establishing an optimum dose for any individual requires weeks. When the correct dose is determined, it is possible to maintain a normal metabolic rate irrespective of the patient's rate when he began taking the thyroxin.

The exact relation between the basal metabolic rate and the amount of thyroxin administered suggests that some definite balance is maintained within the body between the amount of thyroxin circulating in the blood and that functionating in the tissues. This relation, of course, must be maintained by the proper activity of the gland.

Recently in our laboratory we have developed a method for the detection of iodine within the blood and tissues, and by this method we have shown that the normal iodine content of the blood is about 0.013 milligrams per 100 cubic centimeters. What percentage of this is in the form of thyroxin we do not know. However, it is almost all precipitated with the protein, showing that it is organically combined, and it is found in the plasma to a much greater extent than in the cells. These facts are in keeping with the hypothesis that most of the iodine of the blood stream is in the form of thyroxin. If we assume that 100 per cent of it is thyroxin, the thyroxin content of the blood would be one part in five million: the content of the tissues is slightly higher; furthermore, a most interesting seasonal variation has been determined. Seidell and Fenger have shown that the iodine content of the thyroid gland is much higher in summer than it is in winter. We have now shown that the iodine content of the tissues is much higher in winter than it is in summer. This suggests that the total amount in the body throughout the year is about constant, but in the winter it is thrown out to the tissues and is used to produce energy. In the summer less energy for heat is required and the thyroxin is held in the gland.

The physiological dose is from 1/50 to 1/75 milligram per kilo of bodyweight, yet when one thousand times as much as this is administered intravenously to a small dog there is only a slight passing effect, and 30 minutes after the injection the dog appears entirely normal. We had expected to produce a most violent reaction with this amount of the substance, but when almost no effect was produced we examined the distribution of the compound within the animal and found that one explanation of its failure to act is that it is excreted before it has time to function. There seems to be a very rigid control over the amount which the tissues can take up. The normal thyroid also absorbs but very small amounts of thyroxin. Since the tissues do not remove the substance from the blood stream and since the thyroid cannot store it, it is excreted in large amount through the liver and appears in the bile.

If the 200 milligrams administered had been divided into twenty 10 milligram doses, the animal would have died from a maximum degree of hyperthyroidism before the last amount had been injected. Typical symptoms of hyperthyroidism simulating those seen in toxic adenoma are produced by the administration of thyroxin.

These facts emphasize the great difference between epinephrin and thyroxin; the former acts instantly, thyroxin does not begin to function until after many hours and continues for about 3 weeks.

Whenever any physiological process is carried on by the animal organism, energy is

produced and expended. The source of the energy is the food taken in at the mouth. The process by which the food is assimilated and carried to the tissues is fairly well known, but very little is known concerning the mechanism by which it is oxidized to water and carbon dioxid after it has reached the tissues. We were assisted very materially, therefore, in picturing the function of the thyroid when Plummer showed that thyroxin increases the rate at which the body produces energy in mathematical relation to the amount given. The thyroid is used within the tissues to carry out chemical reactions which are closely related with the production of energy. Whether or not life is possible in the complete absence of thyroxin is not the first question to be answered. The important point is to establish the mechanism by which thyroxin functions. When this is done it will explain the fundamental chemical groupings which are used by the body for the production of energy. These same groupings then may be found in substances other than thyroxin. Viewed in this way thyroxin assumes a leading rôle in the body's mechanism to produce energy, and it seems not impossible that the other ductless glands fall into this plan, occupying positions of equal importance for certain other reactions, with this distinction, however, that the thyroid is involved in those reactions which probably result in the production of carbon dioxid. The other glands may be regarded as preparing metabolites for their subsequent reaction with thyroxin.

During catabolic processes certain nitrogen-containing substances result from what may be termed side reactions to the general course of metabolism. When these toxic nitrogen-containing compounds are formed severe symptoms are produced. It would seem necessary that the body be safeguarded from these effects. While we cannot say exactly at which point the parathyroid influences nitrogen metabolism, there is little doubt that it does influence it, protecting the body in some way from the production of guanidine and its derivatives.

When certain of the ductless glands are removed, notably the parathyroid and the adrenal, toxic symptoms develop and the animal dies within a comparatively short time. Although this would indicate that life cannot continue without the functioning of these glands, it is possible that it is only our lack of knowledge and our inability to perfect mechanical devices which would sustain life in the complete absence of these or any other of the ductless glands. It seems probable that the fundamental reactions involved occur entirely in the absence of the active agents of these glands and that they are incorporated in the animal organism to meet emergencies and to give the body a greater range of fluctuations in the production of energy. This is most striking in the myxœdema patient, living at a rate approximately 40 per cent below normal. In this condition the fundamental reactions involved are carried out probably in every detail the same except in the matter of rate. The administration of pure cyrstalline thyroxin permits such a body to increase the rate of the production of energy, and almost miraculously a long train of clinical symptoms is relieved.

In the study of the ductless glands the clinician is guided by the end-results of physiological processes. He is compelled to study these processes indirectly. However, these physiological processes are carried on by definite chemical substances, and when the chemist deals with these compounds he is working in an exact science. The slightest deviation from the necessary chemical structure destroys the value of the substance. It is a case in which "something just as good" will not do. In the co-operation between the chemist and the clinician what will be the greatest aid to the clinician is the isolation of each of the active constituents of all the ductless glands with the determination of their exact chemical influence on the animal organism.

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THE THYROID AND ITS DISEASES[1]

By CHARLES H. MAYO, M.D., F.A.C.S., Rochester, Minnesota

A GENERAL familiarity with the thyroid, its structure, function, and derangements of secretion, with its varying pathology, is steadily growing, and each report on its various phases helps to maintain our interest and add to our knowledge. We know somewhat more of this gland than of any other in the body because of its conspicuous position, which makes noticeable simple enlargements or irregularities. The work of Kendall, representing years of intensive study, has resulted in explaining the chemical nature of the secretion of the gland. His results will, I believe, mark an epoch in medicine. In its possibilities of application to other organs, his work is as yet hardly appreciated by the medical profession, for not only has the active constituent been isolated and its chemical structure identified, but it has been made synthetically, thus giving a new enthusiasm to biochemic research.

The studies published by Magnus-Levy in 1895 on the influence of the thyroid in metabolism were a great advance in medicine and have been supported by others. The present standardizing of the effect of the thyroid secretion on metabolism is largely due to the work of Plummer, aided by Boothby and Sandiford, but made possible by Kendall's work. Boothby's and Sandiford's reports are based on about 18,000 metabolic tests, more than half of which were on patients with thyroid disorders. They not only confirmed that a hypofunction of the thyroid lowers the basal metabolic rate and a hyperfunction raises it, but also, by using Kendall's pure crystalline thyroxin, they have been able definitely to ascertain the amount of thyroxin in the body, the amount normally in the gland, the amount necessary to bring a definite hypothyroidism to normal, and the amount used up each day by the body. This work represents an epitome of the evolution of modern medicine.

The progress in medicine in the last few decades apparently has been due to the study of physiological chemistry in health and in disease. The activity and reproduction of single-celled organisms in suitable environment are apparently controlled by vital cell granules, possibly shown in mitochondria. In multicellular structures chemical activity is controlled by groups of special glands, one of which, the thyroid, if not the most essential to life, is one of the most essential to make life worth living, proved by the results of the mental and physical deficiency of the cretin at birth and by the myxœdematous patient in later life. It is protected for permanency as well as activity by its circulation, which is greater than that of any other gland.

The thyroid secretion makes available the energy of the cells of the body. This gland enables an individual to develop an available active, iodinized secretion from the iodides in food. At times some difficulty arises in the ability of the gland to function; thus simple goiter may be developed. From this standpoint two hypotheses might be considered; first, there is an unusual demand, and second, there is an inability of the gland to function, resulting in a hypertrophy with a failure in

[1]Presented before the Clinical Congress of the American College of Surgeons, Montreal, October, 1920.

some areas of the structure to deliver secretion. Iodine, found by Baumann in 1895 to be a constituent of the normal thyroid, is notably deficient in the gland of exophthalmic goiter and is variable in the gland of adenoma with hyperthyroidism. Moebius, in 1887, suggested a hyperfunction of the gland in exophthalmic goiter. Greenfield, in 1893, observed in six cases that diffuse parenchymatous hypertrophy and hyperplasia were present, and that the gland contained little colloid. Wilson, in 1908, confirmed and elaborated Moebius' theory and Greenfield's statement by a report on the first large series studied (294 cases) and showed that the amounts of hypertrophy and hyperplasia are usually in proportion to the severity of the symptoms.

Goiter appears in practically all countries, and is still believed by some authors to be due to a deficiency of iodine in certain geographic areas. This is hardly a satisfactory explanation for the small proportion of persons affected and the higher percentage of females. Some other and simpler cause at present elusive undoubtedly exists. The reason may lie in the chemistry of infection, toxæmia produced within the gland or at a distant focus, a chemical stimulant, bacterial or other, a problem which has been investigated by McCarrison and attributed to intestinal infection; this may be answered as our knowledge of colloid chemistry develops.

We know that the thyroid is stimulated by the physiological change of menstruation and of pregnancy, and that it is reduced by starvation and increased by overfeeding.

Plummer has shown that there is a variation in the ability of the intestine to absorb iodine. Some patients with myxœdema can be benefited only by the hypodermic administration of thyroxin.

Plummer and his co-workers have not only investigated the thyroid secretion and its relation to basal metabolism, but also presented to the medical profession a basic study of adenoma with hyperthyroidism. Since 1909 Plummer has shown conclusively that the condition resembling exophthalmic goiter and designated in Europe "pseudo Graves' disease," "Basedowized goiter," *formes frustes*, and other terms, but recognized as not the true disease, is hyperthyroidism due to adenoma. Such conditions have not been classified as they should be by American surgeons, falling below the standards of European reports on this subject. Hyperthyroidism occurs in certain goiters of long standing, 14 to 20 years, and is not accompanied by exophthalmos. The iodine content is variable. Mitochondria, shown by the presence of certain granules staining in the cell, may represent activity, possibly of growth, possibly of function. In the thyroid they were first shown by Bensley in the glands the opossum. Goetsch may have a valuable suggestion in showing their presence in adenoma with hyperthyroidism. As a rule, patients have tachycardia in irregular periods and develop irregularity in rhythm and tension. The average age of patients on the appearance of hyperthyroidism is 43 and their average age at operation is 48. In exophthalmic goiter the average age is about 36, and the exophthalmos occurs in 50 per cent within a few months, and in nearly 90 per cent within 2 years; there is tachycardia, but a steady pulse until degeneration occurs late in the disease.

The diagnosis of exophthalmic goiter, as a rule, can be made on signs and symptoms long since recognized as definite. The lymphocyte changes in the blood noted by Kocher have not proved trustworthy. The epinephrin injections recommended by Goetsch, while of value, may produce dangerous reactions or no reactions in well marked cases and may lead to wrong classification in possibly 20 per cent; many psychoneurotics will be placed with the group of patients with exophthalmic goiter. A failure of diagnosis is almost impossible if the basal metabolic rate is taken into consideration with other general symptoms. We have seen a few patients between the ages of 5 and 10 with all the symptoms of marked exophthalmic goiter, and a few between 50 and 60; the average age of patients, however, as they appear for operation is between 31 and 36.

It is not permissible in surgery of the thyroid to classify as adenoma with hyperthyroidism a large percentage of simple goiters which may be operated on with great

safety, much as it might improve mortality rates. Adenomata with hyperthyroidism should average but from 17 to 20 per cent of all cases of goiters with hyperthyroidism. Nor should the two types of hyperthyroidism with increased metabolic rates, tachycardia, and tremor, be confused.

Structurally the thyroid consists of a mass of encapsulated alveoli held together by a stroma of connective tissue, the vesicles lined by a single layer of cells which normally hold some colloid and may accumulate more. So far as we know the secretion in the interior of the vesicle can escape only by passing back through the cells that produced it (Bensley). In exophthalmic goiter there is a crowding of the epithelium and of the vesicles and no retention of secretion. In simple goiter and in the goiter of adolescence, an excess of light-colored secretion from œdema is retained. Later in life a denser deposit of colloid is noted and an encapsulated adenoma often develops on fœtal tissue, or a solid adenoma with colloid or degrees of calcareous and fibrous change, or of cystic degeneration which rarely is toxic. Plummer's suggestion that all the cells of the thyroid are not fully developed or mature at birth, and that later some are stimulated to activity or to hyperplasia, may be a factor in the chain of etiology.

That a goiter probably never wholly destroys the function of the gland has been demonstrated in observations of more than 100 cases of myxœdema and hypothyroidism; two-thirds of the patients had never had a goiter, but the gland had been destroyed by thyroiditis; in others the metabolic rate had been lowered by inactivity of the gland or surgical excess. It is true that simple goiters may occasionally cause low basal metabolic rates, from −8 to −12 per cent. It also has been shown that the basal metabolic rate must be −15 per cent before œdema occurs. The statements often made that removal of the thyroid tissue can be extensive or complete without producing myxœdema or symptoms are not supported by the metabolic rate tests of patients following radical or nearly complete extirpations of the glands.

Hypothyroidism is a better term than myxœdema in describing the true condition. Patients with cretinism are remarkably benefited and patients with myxœdema are cured by the administration of thyroxin. In the adolescent period the treatment of simple goiters that do not disappear of themselves, is iodine, thyroid secretion, or thyroid products. Iodine is slow in affording relief after goiter has developed, but Marine's work among the school girls of Akron, Ohio, shows it to be a prophylactic most useful in the prevention of goiter.

By giving thyroxin in goiter the gland seemingly is relieved of the burden or effort to functionate and is rapidly reduced by supplying the secretion. Operation is advised at any age in cases of round encapsulated adenomata causing distress. Partial removal of both lobes, with removal of the isthmus, is performed for goiter of long standing or goiter resisting treatment. In the preliminary medical treatment of such goiters in patients more than 40, care must be observed in giving iodine, since a degenerative process may be induced by its administration and toxic symptoms develop, a danger appreciated by Kocher. Cancer of the thyroid is rare. The rapidly-growing hard gland, if smooth and even, is probably due to a hæmorrhage in the gland structure. An irregular, hard, and nodular gland is probably malignant, especially if the adjacent lymphatics are enlarged. A hard, symmetrical, small gland that is not exophthalmic may possibly be tuberculous.

THE DANGERS OF OPERATION

In cases of simple goiter the operative risk is from accidents or complications incident to delaying operation past the safe period. Operations in the early stages of exophthalmic goiter should be as safe as those in simple goiter, and here again we divide the work on both sides, using the Mikulicz method rather than the lobectomy of Kocher. After due consideration I may say that a few patients with exophthalmic goiter make good recoveries without operation; others make partial recoveries according to the degree of degeneration or secondary complications. Patients with exophthalmic goiter pass through exacerbations and remissions of symptoms; those in exacerbations are largely

influenced by psychic stimuli and are easily exhausted, in which case they should be medical and surgical patients, and if necessary treated by ligation, rays, hot water injections (17), and absolute rest in order to tide them through the dangerous period. It is a lack of appreciation of surgical responsibility to say that elaborate preparation in serious cases, the use of local and combined anæsthesias, hypnotic, narcotic, or local and general, is unnecessary or useless when the mortality is so low following these methods. Even if the preparation is unnecessary in some cases, it is justified by the general results and will do much to encourage careful examinations, painstaking care, gentleness, and attention to detail in the operation. Experience with success or failure only enables the individual operator to justify methods.

A patient with a metabolic rate of about +66, who has survived a recent exacerbation and is improving, is a safer surgical risk than a patient with a metabolic rate of +46, who is on the rising wave of an exacerbation. With X-ray treatment, remission may occur just as remissions occur without treatment or with several other methods of treatment. Our experience has been failure or but temporary benefit. It is possible that the ray treatment may destroy the gland and produce hypothyroidism. It is difficult to regulate the dosage, and its use adds to the difficulties of operation. It is to be hoped that radiotherapy may be developed into a safe and effective method of securing a cure or relief in preparation for surgery.

In the operative treatment of all patients having difficulty of respiration, usually patients with large goiters and scabbard tracheas, a primary central division should be made of the isthmus with a turning outward of the lobes from the trachea in their resection, as recommended by Balfour. Nerve injury seldom occurs except by crushing with forceps, which can be avoided by the preservation of the posterior capsule and such gland material connected with it posteriorly as it has been decided should be saved; in this manner the parathyroids are also protected.

In the Clinic during 1919, 1,707 of 2,205 operations on the thyroid were performed with ether anæsthesia, 135 with novocaine, and 363 by combined methods. The mortality rate has been greatly reduced during the last 20 years. The old vicious circle of late operation and high mortality and the high mortality conducing to a late operation has been largely overcome. More and more patients with hyperthyroidism are seen early, and the natural risks are thereby greatly reduced. Now only about 20 per cent of these patients come in the late stages. The consequent reduction in mortality is not wholly due to the surgeon's increased ability and technique, but partially to the general advance of professional knowledge and to the diagnostician's co-operation. We were greatly pleased in an early series to perform 46 consecutive operations for exophthalmic goiter between deaths; in a later series 72, and still later 144 between deaths. According to the condition of the patients and best judgment in their treatment, the mortality will vary from 0 to 3 or even 4 per cent in various groups of 100.

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THE PROTECTION OF THE PATIENT IN SURGERY OF THE THYROID

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

My part in a program, the other participants in which are the outstanding figures of the greatest goiter clinic in the history of surgery, is a discussion of the protection of the patient in surgery of the thyroid—of the exophthalmic goiter patient in particular. Against what is the exophthalmic goiter patient to be protected? He should be protected against the fatally excessive metabolism which the operation tends to induce, against failure of the already weakened myocardium, and against acidosis.

These factors may be regarded as end-effects of impairment or failure of the internal respiration of the organism. The total activity of the cell of the liver, of the brain, of the myocardium may be regarded as its internal respiration. What does the cell require to assure the maintenance of its normal, orderly, internal respiration? The cell requires a normal supply of oxygen; a normal supply of fresh water; a normal supply of food—mostly in the form of glucose.

What is the probable state of the cells of the myocardium, of the brain, and of the liver in cases of advanced exophthalmic goiter? The permeability of the membranes of the cells is probably greatly increased as is indicated by the effect of iodism on their electric conductivity. That is to say, the cells of the organs are excessively sensitive, and therefore the patient must be protected against the psychic stimuli of fear and worry before, during, and after the operation. This is accomplished by establishing confidence, by preventing knowledge of the time of the operation, by the exclusion of anæsthetics that produce a stage of excitation.

The abnormal sensitization of the cells in exophthalmic goiter cases necessitates the protection of local anæsthesia, even if surgical anæsthesia is employed also.

These sensitized patients require protection against any infection stimuli; and, in extreme cases, they must be guarded against even the absorption of aseptic wound secretion or of hæmoglobin.

In brief, these patients must be guarded against psychic, traumatic, biochemical, and anæsthetic stimuli; and, in addition, against the effects of the secretion of the thyroid itself. Whether the operation is to be performed with the patient in bed or in the operating room, on the day of operation he should see no surgeon, should see no preparation, should see no operating room, but should see only the already familiar anæsthetist, the already familiar anæsthetic apparatus; should experience only the already familiar odor of the gas and oxygen, and the already familiar sensation of this type of anæsthesia. The end to be achieved is the maintenance of an unbroken state of negativity, while the exquisitely sensitized organism is carried through the processes of the ligation of an artery, and of

[1]Presented before the Clinical Congress of American College of Surgeons, Montreal, October, 1920.

the removal of a part of one or both lobes of the thyroid.

In the absence of other damaging influences, to be discussed presently, the internal respiration, and hence the function of the myocardium, of the cells of the nervous system, and of the cells of the liver are not disturbed by the operation; the appearance of the clinical chart is not disturbed; the patient is safe.

Protection against excitation and against excessive activity is not the only protection required by the exophthalmic goiter patient. Protection against suboxidation is required also. The internal respiration, hence the life of the patient, is immediately dependent upon a continuous supply of oxygen; hence asphyxia, or deep inhalation anæsthesia, quickly suppresses the internal respiration, and causes death, either immediately or within a few hours or a day or more. The clinical course in such a case is similar to that produced by fear, worry, physical injury, exertion, or infection. Since all inhalation anæsthetics cause suboxidation in extreme cases, deep surgical anæsthesia, especially ether anæsthesia, is ruled out. Gas and oxygen analgesia, combined with local anæsthesia, is entirely free from this serious objection. Ether anæsthesia almost wholly suspends the internal respiration and is especially damaging.

As regards the adaptation of the degree of anæsthesia to the individual patient, the judgment of a highly experienced anæsthetist is priceless. In this respect, the judgment of Miss Hodgins, chief anæsthetist of the Lakeside Clinic, is almost unfailing.

A weak myocardium or a decompensated heart leads to serious suboxidation because of the diminished blood supply. Against this condition the patient is best protected by one or two courses of digitalis, each consisting of 30 minims of the tincture of digitalis every four hours for fifteen doses, repeated as may be required until œdema disappears and the tone of the heart is as good as its condition will permit.

A much neglected requirement for the maintenance of the normal, internal respiration is water. Advanced cases of exophthalmic goiter commonly have cycles of vomiting. These may be controlled by sufficient water, for water seems to bear some relation to the cause of vomiting, which rarely occurs if a good water equilibrium is maintained. It is probable that the clinician fails to appreciate the great loss of water through the skin, and that the raging metabolism of the exophthalmic goiter case requires much more water than a normal individual; just as an engine running under full pressure at 60 miles an hour requires more water than an engine running only 25 miles an hour. The goiter case, like the express engine, must be protected against burning out his "boiler" by urging water by the mouth; or if enough cannot be introduced by this normal route, then under the protection of local anæsthesia, from 3000 to 4000 cubic centimeters may be given subcutaneously every 24 hours until the crisis is past.

There is evidence, although it is not conclusive, that the patient should be protected against the too sudden withdrawal of thyroid activity. This danger may be eliminated by the administration of thyroid extract before the operation. By giving 2 grains the evening before, and 2 grains on the morning of the operation, the dose will become effective at the time the thyroidectomy is performed. If, later, the patient seems apathetic, it is well to continue the administration of the thyroid extract for some days. The necessity for providing a more or less gradual decline rather than a sudden decrease in the amount of the thyroid hormone is supported also by the fact that the safest operation is a graded operation: first a ligation of one superior thyroid artery; then, of a second; and finally, after an interval, the length of which is determined by the needs of the individual patient, a unilateral or a bilateral partial thyroidectomy. In a serious situation, even if we could "wish out" the thyroid, the sudden break might be fatal.

In great hazards in which, after the preliminary ligations, a period of physiological rest has brought insufficient improvement, the thyroidectomy is performed with the patient in bed under analgesia and local anæsthesia in order that the already impaired internal respiration may be protected to the utmost from too prolonged general anæsthesia

or from the slight disturbance which attends transit to the operating room, even when the transit is made with the patient under anæsthesia.

If the hazard still is great, and the pulse runs up during the operation, the wound is left open to protect the patient from the absorption of wound secretions and from postoperative pain and also to shorten a hazardous operation by a few but possibly decisive minutes. Following ligation protection against postoperative pain is secured by quinine and urea hydrochlorid. The open wound is protected by flavine gauze dressings, or by sterile dressings which protect the wound almost as well, until its closure under analgesia on the afternoon of the same day or on the following morning. This affords a graded surgical contact.

Finally, and of the greatest importance, the patient must be protected against the so-called postoperative hyperthyroidism. If the pulse and the temperature begin to rise, and restlessness is marked, ice-bags are applied in approximately the following manner: if the temperature reaches 101°, four ice bags are applied to the thorax and the extremities; at 102°, from 8 to 12 ice-bags are applied to the thorax, the abdomen, and the extremities. If the temperature rises to 103° or over, the temperature is reduced by refrigeration, which is accomplished by placing the patient in an ice-pack in the following manner: rubber sheets are placed over and under the patient, who is then entirely covered with from 150 to 200 pounds of cracked ice. An electric fan is mounted at the foot of the bed, the air current being directed toward the patient's face. In case of great urgency, salt may be added. The reduction of the temperature is certain, and as a rule, under this treatment the fall in temperature averages two degrees per hour. The temperature is closely watched while the patient is in the ice-pack, which is discontinued when the temperature has fallen to 100°.

SUMMARY

The "bad risk" patient should be protected—
Against suboxidation,
Against inhalation anæsthesia,
Against want of water,
Against pain,
Against absorption of wound secretions,
Against infection,
Against fear and worry,
Against postoperative hyperthyroidism,
Against postoperative hypothyroidism.

When protection against these is assured the operability of the "bad risk" goiter patient becomes 100 per cent; and the mortality is reduced to that attending the removal of benign pelvic tumors.

The formulation of this plan of treatment has been based upon experimental researches and upon the clinical study of a personal series of 821 ligations and of 2,771 thyroidectomies. Of the latter, 1,315 have been for exophthalmic goiter.

By the application of these measures, the mortality rate of all thyroidectomies has been reduced to 1.3 per cent; of thyroidectomies for exophthalmic goiter, to 1.8 per cent; of ligations, to 0.6 per cent.

Our final series, still unbroken, includes 322 thyroidectomies and 139 ligations without a death.

TUMORS OF THE KIDNEY[1]

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DURING the past 7 years, we have had the opportunity to observe 40 cases of renal tumor which came to operation. The pathology of the growths was, in most instances, proven microscopically. Thirty-eight of the tumors were malignant; two, benign in character, were confined to the renal pelvis and did not involve the parenchyma.

The 40 cases may be classified as follows:

Hypernephroma	28
Mixed tumors (Wilms)	8
Adenocarcinoma	2
Papilloma of renal pelvis	1
Angioma of renal pelvis	1

Because of certain points of clinical and pathological differentiation, it is considered advisable to discuss each group separately.

HYPERNEPHROMA

The high percentage of hypernephroma in our series coincides with the statistics of numerous authors, who have found these growths to be the predominating type of kidney tumor. The following relative frequency of renal tumors, in general, has been reported:

	Kidney Tumors	Hypernephromata	All Other Types
Israel	126	86	40
Albrecht	32	28	4
Barney	114	43	71
Boston City and Massachusetts General Hospital	42	33	9
Mayo Clinic (1911)	56	36	20
Mt. Sinai Hosp. (A. A. Berg)	38	36	2
Pleschner	35	25	10

Hypernephromata are most frequently encountered in the fourth and fifth decades. The age incidence, in our series, was as follows:

Age	Number of Cases
1 to 10 years	1
10 to 20 years	0
20 to 30 years	1
30 to 40 years	3
40 to 50 years	11
50 to 60 years	10
60 to 70 years	2

Most authors state that males are more often afflicted than females. In our group, there were 8 females and 20 males, an unusually high percentage for the latter sex.

The right kidney was diseased seventeen times, the left eleven. Larger series of cases show but slight differences in the side affected. Only occasionally there was a history of heredity; twice it was stated positively that the tumor was noted soon after trauma.

Calculi were found in two of the hypernephromatous kidneys; this finding is not uncommon. In one case, considerable pus was obtained on catheterizing the affected kidney; this with a positive stone shadow, led to a diagnosis of calculous pyonephrosis. Operation revealed a pyonephrotic kidney with a small hypernephroma at the upper pole. The symptoms were caused by the stone and pus kidney, and not by the tumor. Albarran and Imbert (1) collected 26 cases of renal tumor in which stones were present; Coryell (2), reporting 140 kidney tumors from the Mayo Clinic, found calculi associated nine times. One of our cases was complicated by lues and an attack of acute appendicitis which developed prior to operation. An inflamed appendix was ablated through the transperitoneal incision employed for removing the growth. In another instance, a 4 months' pregnancy was associated with the hypernephroma. A transperitoneal nephrectomy was performed, the patient went on to full term and had a normal labor.

Pathogenesis. Since this report deals chiefly with the clinical manifestations of hypernephroma, it is not our intention to enter upon a detailed account of the theories concerning their origin. Suffice it to say, that at present there is still considerable discussion among pathologists and clinicians. The term hypernephroma was first applied by Birch-Hirschfeld (3) to tumors having their origin in adrenal tissue (adrenal rests), located outside the suprarenal gland. These aberrant rests are

[1] Presented before the American Urological Association, March 25, 1920. From the Surgical Service of Dr. Beer, Mt. Sinai Hospital.

most commonly found beneath the kidney capsule, but have also been seen in the liver, in the peritoneum, and in the region of the ovaries. Coeneus (4) has reported a primary hypernephroma of the tongue, without renal or adrenal involvement, and Roedler-Zipkin (5), a hypernephroma of the adrenal without renal invasion. Grawitz's (6) explanation, that hypernephromata are due to aberrant "adrenal rests" was the one most widely accepted for many years until Stoerck (7) and others pointed out certain discrepancies, and claimed that they were renal in origin. At the present, Stoerck's views are most commonly accepted. Wilson (8) has lately advanced the theory that hypernephromata are not adrenal in origin, but are "included islands of nephrogenic tissue," originating from the remains of the wolffian bodies, and suggests calling them mesothelioma.

Pathological anatomy. Hypernephromata vary considerably in size and location, and may be found in any part of the kidney. It was stated at one time that most of them were situated in the upper pole. This, however, has been disproved, and more often the tumor is found near the center of the kidney or at the lower pole.

A peculiar characteristic of these growths is their tendency to break into the renal vein, which at operation or postmortem is found occluded by masses of tumor tissue. Cases have been reported in which the vena cava has been so involved, and in which the thrombosis extended to the heart. In one instance, in this series, the hypernephromatous thrombus extended over to the opposite renal vein. In eight others, the renal vein on the affected side was found infiltrated at the time of operation. Bloch (9) found extension into the renal vein, in 13 of 86 cases. Of interest is the fact that such a thrombus may be present in the vena cava without producing œdema of the lower extremities. Hypernephroma metastases are not infrequently solitary. Cases are reported in which a single secondary growth has developed years after nephrectomy; a few have been successfully removed. Occasionally, the first evidence of the disease has been the appearance of one or more metastases in the bone, without any clinical manifestations of malignancy on the part of the kidney. Since the metastatic growths present the same pathological structure as the primary hypernephroma, the diagnosis of such a condition is not difficult. There are also points of differentiation by which these metastatic bone tumors can be recognized roentgenographically. A short time ago, we observed a young man, who on physical examination disclosed a prominent tumor in the region of the liver. There were no symptoms referable to the kidney, not even microscopic blood. At operation the liver was found studded with hypernephromata. In such cases the question arises whether we are dealing with a metastatic tumor of renal origin, or one of the rare cases of liver hypernephroma. When last seen, a few months after operation, there were no symptoms or clinical manifestations of renal involvement. The metastases are most frequently located in the long bones, the bones of the skull, and in the lungs and the liver; the brain and spinal cord are not infrequently involved. Dissemination by way of the lymphatics is unusual, but occasionally the retroperitoneal glands have been found involved. The secondary growths may occur very late in the course of the disease; numerous instances being reported of metastases developing 4 to 5 years after the appearance of the primary tumor or after nephrectomy. Clairmont (10) has reported a case in which the metastasis appeared 10 years after the kidney was removed; Albrecht (11), a similar one with a secondary growth developing seven years after nephrectomy.

Symptomatology and clinical signs. The most frequent initial symptom is hæmaturia, then pain, and finally tumor formation. Unfortunately, the presence of this combination of symptoms generally signifies a condition far advanced. From a careful study of the 28 cases in our series, it is evident that hypernephroma is seldom diagnosed in an early stage. This is due to a number of factors; some of them within the control of the physician. A short time ago an excellent pamphlet on cancer was distributed by the U. S. Health Service to the lay public. It laid emphasis on the evil consequences of delay in cancerous conditions of the various

organs, and urged the necessity of early recognition and immediate attention to symptoms of breast, uterine, tongue, and other carcinomata. No mention, however, was made of a very frequent urological symptom: hæmaturia. If we are to make an early diagnosis of malignancy of the urinary organs, it will only come about through a campaign of education; impressing upon the laity the necessity and importance of a careful examination upon the first appearance of blood in the urine. It is, alas, only too true, that often the initial hæmaturia denotes a far advanced hypernephroma; in numerous instances, however, it is but a warning of impending danger. The importance of hæmaturia in this disease is made evident by noting that in from 50 to 70 per cent of the cases recorded in the literature, it was the primary symptom, and was present, in even a larger number, during the subsequent course of the disease.

The following tabulation of our cases, showing the duration of one or more of the cardinal symptoms of hypernephroma (hæmaturia, pain, tumor), prior to operation, may be of interest:

	Cases
1 year	6
2 years	4
3 years	5
4 years	1
8 months	2
7 months	1
6 months	3
1 to 5 months	6
Total	28

As previously mentioned, it has been observed that not very infrequently the disease has already made such rapid progress upon the first appearance of hæmaturia, as to preclude the possibility of a cure. Thus in Case 3, in which the initial hæmaturia was observed 8 weeks previously, the growth had already invaded the renal vein, and a pulmonary metastasis was present.

It is unfortunate that the hæmaturia is so often transient and intermittent in character. In looking over our records, one is struck by the fact that frequently the first attack of hæmaturia was observed years (1 to 3) prior to examination. The cessation of bleeding without medical treatment, followed by a long intermission before the appearance of the next hæmaturia, served to lull these patients into a false sense of security. In 28 cases, bloody urine was found macroscopically 16 times; in 8, the blood was microscopic; only in 4 cases was it absent. In numerous instances, typical ureteral blood casts were passed, several times, unaccompanied by the usual colic-like pains. The bleeding is occasionally most profuse, instances being recorded where one hæmorrhage proved almost fatal. According to Danaclara (12), the hæmaturia associated with hypernephroma is not a prolonged one, as in bladder tumor or other conditions; in but one case of a series of 146, did the attack last as long as 2 weeks.

Pain is a variable symptom and two types must be differentiated: that due to the passage of clots with consequent distention of the pelvis, and a spontaneous pain, independent of any bleeding. Pain often precedes other symptoms or signs of a tumor, by many years, and may be the only symptom present. The pain is of three varieties, either dull, neuralgic, or colic-like in nature, the radiation being generally along the distribution of the ilio-inguinal and genitocrural nerves. Pain as an initial symptom is present in from 30 to 40 per cent of the cases. In our series, at least 40 per cent of the patients complained of lumbar pain some time or other during the course of the disease; in a few, this symptom preceded macroscopic hæmaturia by 2 to 5 years.

Tumor is present in 60 to 80 per cent of cases that come to operation. Undoubtedly small growths, especially when situated in the upper pole of the kidney and hidden behind the ribs, are frequently overlooked. It is of significance that in 28 cases a palpable tumor was present in 24. The percentage of positive findings will depend a great deal upon the individual skill in such manipulations. Israel (13) reports palpating a hypernephroma, the size of a walnut. Examination in the lateral position may aid considerably in outlining a tumor. The tumors vary considerably in size, shape, and relation to the surrounding tissues. The small growths are generally hard and nodular, the large ones vary in consistency, from extreme hardness to semi-fluctuation, and are very often firmly fixed in their posi-

tions. These firmly adherent tumors generally proved to be inoperable. Attention may here be called to the dangers of rough palpation; hæmorrhage may be produced, and the possibility of pressing out tumor fragments into the general circulation must be considered. Inflation of the colon may aid in confirming the retroperitoneal position of the growth, small tumors as a rule lying posterior to the colon, larger ones displacing the colon inward.

In summarizing the three cardinal symptoms of renal tumor as presented in our series, we find hæmaturia the most frequent initial symptom, and present in over 90 per cent of cases, some time during the course of the disease. Pain as an initial symptom was noted in 30 per cent, and was present in more than 40 per cent at one time or another. A tumor was palpated in 85 per cent of the cases. A number of patients complained of all three symptoms, and in more than 85 per cent two of the classical symptoms were present. This résumé will serve to indicate the difficulty of making an early diagnosis of hypernephroma.

Symptomatic varicocele painless, and rapid in formation, on the side of the growth was first noted by Guyon. It generally disappears after operation, and differs from idiopathic varicocele in that it does not disappear on lying down; and its first appearance is observed in middle or advanced years. In none of our cases were we able to demonstrate this phenomenon. A few patients complained of loss of weight, weakness and gastro-intestinal disturbances. Cachexia is usually a late manifestation, patients often noting symptoms for years before the general health becomes affected. Fever, between 100° and 102° was observed in a few instances, without the presence of pus in the urine; its significance is not clear; Israel (14) reports its presence in 57 per cent of his cases.

All the symptoms enumerated above may be considered under the caption of clinical manifestations. Of equal importance and practically indispensable are the data obtained by special urological examinations. Pain and hæmaturia may be due to any number of urinary conditions which can only be differentiated by a proper use of the cystoscope and X-ray.

Urological diagnosis. The importance of a careful urinalysis cannot be too strongly emphasized, especially on account of the frequency of microrcopic blood. Tumor cells are rarely found in the urine. Radiography by outlining the size and shape of the kidney, will often prove of value. In a number of cases, we have been able to exclude a tumor by a roentgenogram, showing a perfectly normal kidney shadow. Enlargements and irregularities of renal outline are readily seen. The association of stone with tumor should not be overlooked, and due allowance made for this occurrence. Skiagraphy should also be employed for determining the presence of metastasis in the bones or pulmonary system, prior to operation.

Renal function. Our mode of procedure is as follows: A phenolsulphonepthalein estimation of a two to three hour bladder specimen to ascertain the functional capacity of both kidneys, is followed by a determination of urea, uric acid, and creatinin in the blood. A complete cystoscopic examination, including ureteral catheterization is then performed, in conjunction with indigocarmine as a test of individual kidney function. To exclude hydronephrosis, calculus, and other conditions, additional tests combined with cystoscopy may be deemed advisable. Briefly mentioned, these are the distention test, to determine the nature and location of pain, and to ascertain the capacity of the renal pelvis; and the passage of wax tipped bougies to exclude calculus. A study of the indigocarmine excretion in our series of hypernephromata showed that in many cases the function of the diseased kidney was considerably diminished, and in numerous instances entirely absent. Functional tests, whereas of value in determining the degree of renal impairment, are not of particular diagnostic importance when judged alone, because similar findings are encountered in so many other conditions. Studied carefully in conjunction with the history and physical examination, their significance increases. Blood clots were often seen protruding from the ureteral orifice on the side of the diseased kidney. Forcible manipulation of

the ureteral catheter in the renal pelvis with the idea of traumatizing the growth and producing bleeding, as recently described by Beer, will prove of value occasionally. In two cases with clear urine, and absence of tumor and lumbar pain, it was only possible to determine the affected kidney by producing a hæmaturia on the diseased side by this procedure. Pyelography, by revealing certain characteristic deformities in the renal pelvis and calyces, will occasionally prove of considerable aid in the diagnosis. Braasch (16) found distortions in pelvic outline seventeen times in 22 cases. In our series, pyelography was only occasionally employed; in two instances, data so obtained aided in establishing the diagnosis.

Diagnosis and differential diagnosis. As previously stated the disease is seldom diagnosed in an early stage. In the cases presenting the cardinal symptoms (hæmaturia, pain, tumor) the diagnosis is almost self-evident. The difficulty arises in differentiating the initial symptoms, pain and hæmaturia. Persistent lumbar pain, with or without hæmaturia in a middle aged individual should arouse suspicions of malignancy, and render necessary the examinations previously mentioned. Calculus, tuberculosis, and pyogenic infections can usually be excluded as etiological factors; the absence of these conditions would tend to strengthen the suspicion of renal tumor. Pyelography may be of valuable assistance in such an early case. When in doubt, an exploratory incision is indicated.

It is not always possible to differentiate between hypernephroma and other malignant kidney tumors. As previously mentioned, hypernephroma is the most frequent type of renal tumor, the course of the disease is often slow in progress, the symptoms extending over a period of years, cachexia is a late manifestation, and single metastases are not uncommon. Hæmaturia is not as pronounced as in carcinoma and the intervals between attacks of bleeding are often years apart. In carcinoma, cachexia appears early, the course is rapid, and metastases are multiple.

Treatment. There is only one recognized form of treatment, and that is early nephrectomy. Radium and deep X-ray therapy have not as yet usurped the place of the scalpel in this condition. They are to be employed after operation and may be of value in preventing local recurrences. Resection of malignant kidney tumors, no matter how small the growth, is not to be considered.

The question arises as to the advisability of nephrectomy in the presence of a metastatic deposit. Radical surgery, of course, is not to be considered if multiple growths are found disseminated. Under certain circumstances (uncontrollable renal hæmorrhage), as a life saving measure, it may become necessary to remove the kidney, even though an inoperable secondary deposit is present. A single metastasis readily reached surgically, and in the absence of cachexia, should not contra-indicate radical operation. The kidney should first be extirpated, followed as soon as possible by the excision of the secondary growth Albrecht (16) has reported a few instances in which patients lived for years following the removal of a secondary deposit. Of these, one case in particular is interesting; nephrectomy was performed 12½ years ago, 3 years after a metastatic bone tumor in the scapula was extirpated and the patient was still alive 9 years later. It is advisable before operating to radiograph all the bones and the lungs, to exclude metastases producing no symptoms. A large firmly fixed growth, which has broken through the capsule and invaded the surrounding tissues, should deter one from operating, as it will be impossible to do a nephrectomy in such a type case. Whenever in doubt, however, the patient should be given the benefit of an exploratory operation.

An important point, still a matter of discussion, concerns the method of approach (lumbar or transperitoneal). In small or moderate-sized growths, the lumbar route is advisable; with very large tumors the transperitoneal operation is preferable, as a better exposure is obtained, rendering it simpler to mobilize the kidney, especially when it is adherent. The latter incision permits of easier approach to the pedicle, and also has the added advantage of enabling one to determine the presence of secondary intra-abdominal deposits, which would render further procedures useless. It is desirable to ligate

the renal vein as early in the operation as possible to prevent neoplastic tissue from being squeezed into the general circulation by forcible manipulations in delivering the kidney. The renal vein should be ligated as close to the vena cava as possible, and attempts should be made to extract tumor thrombi that may be present. A transverse incision has also been recommended, dividing all the lumbar muscles transversely to the median line in front, and then opening the peritoneal cavity.

In our series of 28 operations for hypernephroma, there were 20 nephrectomies. The lumbar route was employed sixteen times; the transperitoneal, four. In eight cases operation revealed an inoperable growth, either on account of extension and adhesion to surrounding parts, or because of the presence of intra-abdominal metastases. Five of these explorations were transperitoneal operations. As previously mentioned, the renal vein was found thrombosed nine times. Specimens for microscopic examination were removed in all but two of the growths, which proved to be inoperable.

Anæsthetic. Gas and ether anæsthesia was generally employed, occasionally gas and oxygen. Two patients were explored under local, and one was nephrectomized under spinal, anæsthesia. In the latter instance the patient's general condition was very poor, the anæsthesia was perfect, and the kidney successfully removed.

Operative mortality. Statistics from various clinics reveal considerable differences in mortality figures. Albarran and Imbert report an operative mortality of 23 per cent for lumbar nephrectomy, and 21 per cent for the transperitoneal operation; Albrecht, 24 cases, 33.3 per cent mortality; Pleschner, 25 per cent; Israel, 18.6 per cent; Garceau, 30 per cent; Braasch, 11 per cent; Paschen, 11 per cent; Berlstein, 33.3 per cent. Pleschner (17), in reviewing the literature, reports the following mortality statistics for the various types of operation:

Types of Operation	Per Cent
Transperitoneal nephrectomy	37.5
Lumbar nephrectomy	13.5
Lumbar nephrectomy with opening of peritoneum	33.

Most of the deaths have been due to cardiac insufficiency, pneumonia, peritonitis, and uræmia. Cardiac failure has been mentioned as the cause of death in an unusually high percentage of cases (66.7 per cent Israel, 18). Israel attributes this to a toxic myocarditis, due to breaking down of hypernephroma tissue, and notes that cardiac failure is more frequently observed in cases in which the vena cava has been invaded by the growth. In the majority of cases there were no previous evidences of cardiac disease.

Of the 28 patients operated upon in this series, there were twenty nephrectomies with 1 death, a mortality of 5 per cent. This patient died with uræmia manifestations 10 days after operation; at postmortem, it was found that the growth extended from one renal vein into the vein of the opposite kidney. Among the 8 exploratory operations, 1 patient died 6 days after, from general weakness. This operation was performed under local anæsthesia, and an inoperable tumor found.

Course of disease and remote results. The disease is often very slow in progress up to a certain point, after which the virulence seems to increase, and the patients rapidly lose ground. It is not unusual for patients to present symptoms 2 to 5 years before seeking relief. The prognosis in general is bad, death occurring from recurrence or metastases, as late as 10 years after operation.

The majority of recurrences take place within the first 2 to 3 years following operation; and although reported, are very infrequent after 5 years. Clairmont describes a case in which death took place 10 years after operation, from a metastasis in the chest, and Albrecht's patient died from metastases 7 years after nephrectomy. The size of the growth apparently bears little relation to the prognosis. Small growths have been known to metastasize as quickly as larger ones. Involvement of the renal vein does not necessarily render the prognosis fatal, although it diminishes considerably the chance of a cure. Albrecht (19) reports 2 cases in which the veins were thrombosed with hypernephroma tissue at the time of operation; one patient was alive and well, 4 years after, the other patient was well when last observed 12 years after nephrec-

tomy. In 2 cases in our series, the renal vein was found partially occluded with hypernephroma tissue at the time of operation. Both patients are alive, without evidence of recurrence or metastasis, 4½ and 3½ years after operation. The chances for a cure are considerably diminished if the tumor has broken through the capsule of the kidney. The following table may prove of interest:

	Postoperative Mortality Percentage	Recurrence Percentage	Cures (at least 3 years) Percentage
Albrecht	33.3	56.2	37.5
Pleschner (20)	25.	53.3	35.
Paschen (21)	11.1	31.4	35.1
Berlstein (22)	33.3	66.6	22.2

The question arises, when can a patient who has had a hypernephroma be considered cured. This is not so easily answered, for although most of the recurrence takes place within a few years, it is characteristic of hypernephroma to metastasize very late. Besides cases previously mentioned by Clairmont and Albrecht, Fischer reports a metastasis appearing 6 years and 9 months after nephrectomy; Kroenlein, 6 and 11 years after, and numerous instances, 4 to 5 years after.

It is difficult to give estimates of cures in hypernephroma, with any degree of accuracy, but most statistics bear witness to the extreme malignancy of this condition. Albarran and Imbert are of the opinion that about 28 per cent are cured. In the 16 cases reported by Albrecht, 9 died from recurrence or metastasis, 6 were still alive; of these, but 2 had passed the 3-year period. Of Israel's 34 cases, 18 died of recurrences within 2 years' time. In Watson and Cunningham's report of 143 cases, 31 patients were found to be living; only 9 of these had passed the 3-year limit. In a series of 43 cases in which nephrectomy had been performed, Garceau (23) reported 39 as having died within 3 years; 33 of metastasis. Braasch (24) reports 27 per cent of 3-year cures and 10 per cent of 4-year cures, following nephrectomy, and Kuester (25), 11 per cent cures at the end of 4 years. Of 25 cases reported by Berg (26) in his first series, all had died within 7 years; of 13 cases in the second group, 6 were known to be dead at the time of publication of the article. Stoerck is of the opinion that the course of the disease can be explained by the pathological anatomy of hypernephroma and distinguishes two types of the disease, benign and malignant. In the first variety the tumor is sharply encapsulated from the surrounding kidney tissue. These growths may be present for years, without causing symptoms. In the second or malignant type, the tumor breaks through its capsule, and into the general circulation producing metastasis.

The result in our series may be tabulated as follows:

Number of cases operated upon	28
Number of nephrectomies	20
Died following nephrectomy	1
Exploratory operations (all inoperable)	8
Died following exploratory operations	1
Deaths within first year from recurrence or metastases	9
Deaths in second year from recurrence or metastases.	5
Data not obtainable	6
Nephrectomized cases with complete postoperative data	12
Alive 6 months after nephrectomy	1
Alive 1 year after nephrectomy	1
Alive 3½ years after nephrectomy	1
Alive 4½ years after nephrectomy	2
Alive 7½ years after nephrectomy	1
Percentage of cures over 3½-year period	33.3

It is of interest to note that 3 patients who have already survived nephrectomy 3½ years, had well advanced processes. The kidney in one was densely adherent, and the growth had perforated through its capsule into the renal pelvis. In the other 2 cases, the renal vein contained hypernephroma thrombi at the time of operation.

MIXED TUMORS OF THE KIDNEY

Wilms tumors (27) are most frequently encountered in the first 3 years of life; occasional cases in the adult are observed. In a series of 165 mixed kidney tumors reported, 131 appeared within the first 6 years of age. These growths are supposed to take origin in embryonic tissue, and are composed of collections of epithelium, in the nature of tubular or glandular structures, containing besides smooth and striped muscle fibers, cartilage, fat, bone, and proliferating connective tissue of mesothelial origin. The latter tissue is the one most frequently found. The tumors originate in the substance of the kidney and grow directly into the parenchyma, but do not

infiltrate as the sarcomata or carcinomata generally do.

The sex and age incidence in our series was as follows:

	Sex	Age Years
Case 1	Male	6
Case 2	Female	2¾
Case 3	Male	1½
Case 4	Female	3
Case 5	Female	3
Case 6	Female	4
Case 7	Female	22
Case 8	Male	3

Trauma has been mentioned as a predisposing cause; such a history was obtained in one case. In Case 8, the disease was bilateral. Walker reports 10 such instances in 141 cases. Clinically, mixed tumors are characterized by their large size (at times filling almost the entire abdominal cavity), absence of pain in most instances, and apparent good health of the patient. Cachexia is a late manifestation. Often subjective symptoms are absent and the growth is not discovered until it has reached a very large size. Metastases are relatively infrequent. These growths are exceedingly malignant, and death is generally due to local recurrence and cachexia. Hæmaturia is not a prominent symptom, and when it does take place is usually not severe.

In the series under discussion, pain was present in 4 cases, hæmaturia in 3. The diseased kidney was markedly enlarged in all 8 cases. Gastro-intestinal symptoms were not uncommon, fever was occasionally present. The urine with the exception of red blood cells showed no changes. The dense shadow of the enlarged kidney was clearly shown in the roentgenograms. Three of the children in the group were cystoscoped prior to operation and showed absence of secretion and function from the diseased kidney.

Treatment. Nephrectomy as early as possible offers the only hope of a cure. The size of the growth should not contra-indicate its removal. The same general principles prevail as previously mentioned for nephrectomy in adults. The danger of shock and hæmorrhage are greater than is the case with adults, and speed is a desideratum. As to the method of approach, the transperitoneal is the route usually employed. Most of these growths are too large to permit of removal through a lumbar incision. The operative mortality statistics in 122 cases, collected by Albarran and Imbert, was 24 per cent. Walker, in 74 nephrectomies, reports a mortality of 36 per cent. In our series of 8 cases (5 nephrectomies, 2 incomplete operations, and 1 exploratory with removal of specimen), there was 1 death 8 days after operation, a mortality of 12.5 per cent. The fatality occurred following an incomplete operation; the tumor was exceedingly friable and was literally scooped away. The prognosis is very bad, most of the recurrences taking place within a year after operation. The mortality from operation and subsequent recurrences is between 86 and 93 per cent. In our series of 7 cases surviving operation, 4 died within 6 months of local recurrences, 1 died within the year; 1 patient, a girl of 22 years, is alive and well, 5 years after operation. This patient has lately gone through a normal pregnancy. Data could not be obtained of the other surviving patient.

ADENOCARCINOMA

These tumors are rare. There were 2 cases in our series. In general, it may be stated that the disease is of much shorter duration than hypernephroma, and is decidedly more malignant. Instead of years, as in the latter condition, the course is often only a matter of months. The pain is much more constant and severe, the course of the disease more rapid, and cachexia appears earlier than in hypernephroma. Hæmaturia is more pronounced and the intervals between bleeding, shorter. The tumors do not attain the size of hypernephroma, but rapidly infiltrate and become adherent to the surrounding tissues. In the first case, the growth was situated in the upper pole of the kidney, and hard nodular glands were found in the region of the iliac vessels and aorta. The pathological report of the tumor was papillary carcinoma. There was a fatal termination of this case within the year. The second case had unusual features. The patient, a man of 54 years, was operated upon for a renal calculus which was removed through a pyelotomy incision. A small growth seen near the hilus of the kid-

ney was extirpated and reported papillary adenocarcinoma by the pathologists. A secondary nephrectomy was performed one week later. This patient is well now, one year after operation.

PAPILLOMA AND ANGIOMA OF THE RENAL PELVIS

Tumors of the renal pelvis are rare. Israel reported 6 in his series of 126 cases of kidney tumors. Of 94 tumors at the Massachusetts General and Boston City Hospital, there was but one pelvic tumor, a papilloma. Binney (28) found 5 such growths in 105 cases. Albarran collected 42 cases, reported up to 1900. Judd (29) reports 3 in a series of 207 kidney tumors from the Mayo Clinic. The type of growth most commonly found in the pelvis is a papilloma, either malignant or benign. These tumors do not infiltrate the kidney tissue, but have a tendency to become implanted along the course of the ureter or in the bladder. The symptoms in general are those of renal tumor; hydronephrosis or hæmatonephrosis is frequently present. The diagnosis is seldom possible unless tumor cells are found in the catheterized specimens, or a growth is seen projecting from the ureteral orifice, or its immediate neighborhood. The association of a vesical tumor with renal hæmaturia is characteristic of this condition. Pyelography by demonstrating pelvic distortion and irregularity, should be of considerable value in the diagnosis.

In our patient, a male of fifty years, there was a history of recurrent bleeding for 18 months. The physical examination was negative. Cystoscopy revealed a small papilloma on the inferior lip of the sphincter, which was destroyed by means of high frequency treatment. The hæmaturia, however, persisted and on ureteral catheterization bloody urine was obtained from the left kidney. The patient died in the hospital from an apoplectic seizure. Postmortem examination showed a large papillary tumor in the pelvis of the left kidney. There were no ureteral growths. Pathological diagnosis: papilloma of pelvis of kidney, with implantation tumor of bladder.

The last case in this series is a most unusual one, in fact I have not as yet found its duplicate in the literature. The patient, a male adult, gave a history of intermittent hæmaturia, accompanied by right renal lumbar pain, of long duration. A tentative diagnosis of renal tumor was made. At operation, a normal sized kidney was found, with no evidences of a growth. The pelvis, which felt thickened, was then opened and disclosed a typical angioma, involving the whole of the pelvis and extending into the calyces. The growth was raised from the mucosa, and consisted of an irregular twisting mass of dilated blood vessels, presenting the appearance of a bunch of worms. In view of its extent, the angioma could not be resected, and nephrectomy was deemed inadvisable. The patient was seen about 5 years later, and except for a few attacks of bleeding, was otherwise well.

In conclusion I wish to call attention to the extreme malignancy of kidney tumors. Eleven of a total of 38 malignant growths were found to be inoperable. Twenty-seven nephrectomies were performed with 2 operative deaths, a mortality of 7.4 per cent; 23.3 per cent of the patients have passed the 3½-year period, whereas 58 per cent died within 2 years after operation, from recurrence or metastases. The only way to offset this high mortality is by early diagnosis and operation; this can be brought about by closer co-operation between the patient, general practitioner, and the surgeon.

Addenda. Since presenting this paper for publication four additional cases of tumor of the kidney have been observed, making a total of 44 renal neoplasms. The diagnosis was readily made in three instances, the classical symptoms of renal tumor (pain, tumor, hæmaturia) being present. The pathology of these growths was varied; one was a hypernephroma, one a sarcoma, the third a papillary carcinoma, and the fourth a papillary adenocarcinoma. All four patients were adults over 40 years of age. The case of hypernephroma presented unusual diagnostic difficulties, as there was no tumor palpable. The hæmaturia was intermittent in character and numerous hyaline and granular casts were present. As these findings had persisted more than a year, with no loss of weight, a

diagnosis of nephritic hæmaturia was made for which the patient was treated in a few hospitals. The diagnosis was made on the pyelographic data, and the attacks of bleeding produced by forcible manipulation of the ureteral catheter in the pelvis of the kidney.

All four patients were nephrectomized and made good operative recoveries. In the papillary carcinoma, it was found that the renal vein and the vena cava as far as could be palpated were completely thrombosed with tumor tissue. Such a finding is unusual for this type of tumor. This patient died a few months after leaving the hospital, the other three are alive and in good condition.

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THE YOUNG–STONE OPERATION FOR URETHRORECTAL FISTULA

Report of Three Cases[1]

By EDWIN G. DAVIS, M.D., F.A.C.S., Omaha

In 1913 Young and Stone (1) presented an operation for the radical cure of post-operative urethrorectal fistula, including reports of 3 cases. Four years later, in a second publication (2), they were able to add 8 more cases, making a total of 14, all but 1 of which were successful. In brief, the Young-Stone operation consists of a radical perineal dissection, the essential feature of which may be compared to an exaggerated Whitehead hæmorrhoidal operation, whereby a cuff of the rectum is dissected free and pulled down far enough so that amputation may be performed above the fistulous opening. Other important features of the operation are (1) suprapubic drainage, (2) urethral closure, and (3) the bringing together of fascia and levator fibers in the mid-line to act as a barrier between urethra and rectum.

Eloquent proof of the unsatisfactory results heretofore obtained by other less radical procedures is the number of previous operative attempts reported by almost all of the patients who presented themselves with this lesion. One case here reported had had eight attempts at closure, and, of the series of Young and Stone, six had had as many as three previous operations. The cure of urethrorectal fistula has been one of the most difficult problems in surgery, and it is for this reason that the rectum has always been a menace in any operation requiring perineal approach to the posterior urethra. The series of 11 cases reported by Young and Stone, together with the 3 herewith presented, makes a total of 13 successful cases out of a possible 14 — certainly a sufficiently high percentage to establish without question the

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Fig. 1. The racquet-shaped incision beginning at the mid-point of the perineum and extending posteriorly encircling the anus at the mucocutaneous juncture.
Fig. 2. The final approximation of the skin.

merit of the Young-Stone technique. The articles describing this technique both appeared in strictly urological publications of rather limited circulation. In view of this fact, and contrasting these splendid results with the notoriously poor results heretofore obtained, it seems worth while to call the attention of the general surgical profession to the value of this operation.

It is to be noted that the type of case under consideration does not include those fistulæ of tuberculous or cancerous origin, but only those occurring as the result of surgical trauma. Of the total of 14 cases, 2 resulted from perineal lithotomy, 5 from drainage of a prostatic abscess, and 7 from perineal prostatectomy. The diagnosis is very simple. The characteristic feature is, of course, passage of gas *per urethram* and urine *per rectum*, which, coupled with the history of a previous perineal operation, leaves little doubt as to the condition. The diagnosis is confirmed by rectal examination, revealing an opening in the mid-anterior rectal wall, within 1 or 2 centimeters above the sphincter ani, and communicating directly with either the membranous or the prostatic urethra, usually the former. Rectum and membranous urethra are normally so closely approximated that the length of the fistula is never more than 3 or 4 millimeters. All of the cases presented extensive perineal scarring, both superficially and deep, particularly those which had passed through numerous operations; and more than half were complicated by the presence of a communicating perineal fistula. Five had in addition partial incontinence of fæces due to a division of the sphincter ani, and 3 had urinary incontinence on account of an injury to the internal vesical sphincter. During the cystoscopic examination of one of these latter, the dilated sphincter made it possible to withdraw the cystoscope into the posterior urethra and obtain a view of the fistulous opening into the rectum. Considering the extensive scarring always present, and the various complications presented by communicating perineal fistulæ and by damaged bladder and rectal sphincters, the operation in each case was undertaken under most discouraging conditions.

OPERATIVE TECHNIQUE

Suprapubic. The simplest portion of the operation, but not the least essential, is suprapubic cystostomy, performed to protect the perineal sutures from urinary infiltration and muscle spasm. In 2 cases of the Young-Stone series, and in 1 case reported below, there was urinary incontinence, due to a damaged vesical sphincter, which it was possible to repair successfully through the suprapubic incision, according to a technique later described by Young (3). In these cases the Davis vacuum drainage apparatus (4) was of advantage in keeping the bladder dry and preventing urinary leakage through the perineum.

Perineal. A clear idea of the technique of the perineal dissection is best obtained by a study of the illustrations.[1] With the patient in the exaggerated lithotomy position, a racquet-shaped incision is made, extending from the mid-point of the perineum downward, including the communicating perineal fistula if such exists, and encircling the anal opening

[1] The original illustrations were kindly loaned by Hugh H. Young.

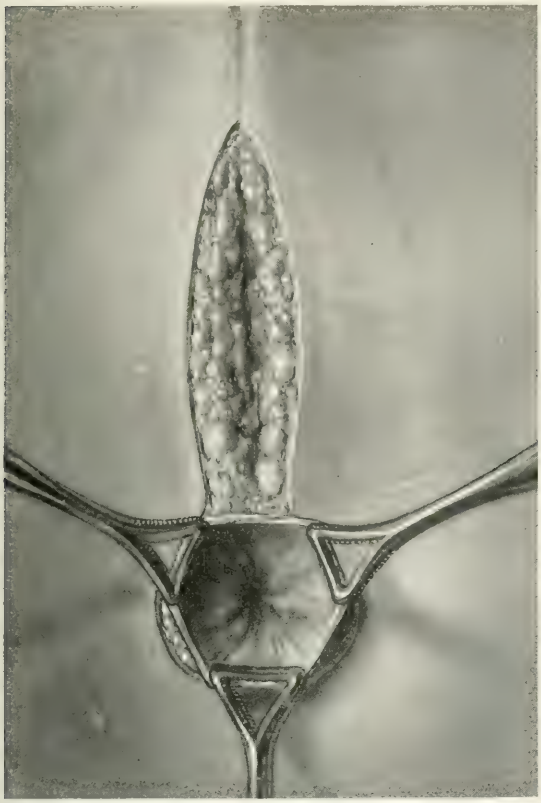

Fig. 3. The first step in the freeing of the rectal mucosa from the underlying structures.

Fig. 4. The mucosa has been freed to a point well above the fistulous opening and the sphincter ani muscle has been divided.

at the mucocutaneous juncture (Fig. 1). A dissection of the rectal mucosa is then begun, freeing a cuff of the latter and pushing back the sphincter as in the Whitehead operation for hæmorrhoids (Fig. 3). To begin the operation in this manner discloses cleavage planes which are of great assistance in the next stage which consists of freeing the rectum anteriorly where it is involved in dense scar tissue and intimately associated with the urethra. It is at this stage that the greatest difficulty is encountered. To separate the rectum and urethra without injuring either, and then to continue the dissection through scar tissue as far back as the base of the prostate, peeling back the rectum from the prostatic capsule without the aid of the cleavage plane, normally offered by Denonvillier's fascia, requires great patience and at best is unavoidably time-consuming. Yet, if the operation is to be successful this dissection must be continued, despite difficulty, high enough to mobilize a sufficient length of rectum so that amputation of the fistula-bearing cuff may be performed, leaving a normal rectal stump, which may be sutured flush with the skin edge, *without tension.* The procedure is facilitated by a deliberate division of the sphincter ani anteriorly (Fig. 4). The dissection is then completed by a thorough exposure of the urethral opening which may involve the membranous urethra only, or which may extend well back into the prostatic urethra (Fig. 5). Closure is now a relatively simple matter (Fig. 6). As important as the closure of the urethra itself is the bringing together in the mid-line of fascia and levator ani fibers, making a

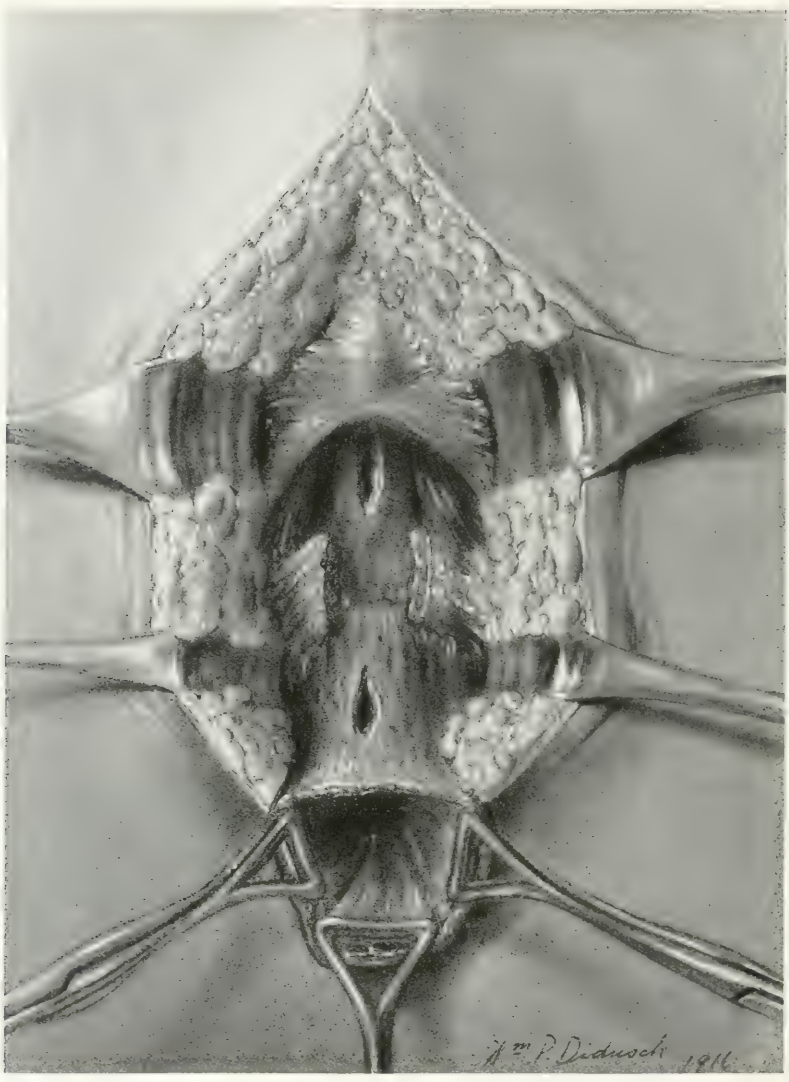

Fig. 5. The dissection has been carried down through the perineal body and the urethral orifice of the fistula exposed.

second layer over the urethra, and completely separating this structure from the rectum. In those cases where the sphincter ani has been previously divided, scar tissue may cause difficulty in the isolation and repair of this structure (Fig. 6).

The final stage of the operation is the amputation of the rectal cuff (Fig. 7) and the suture of the rectal stump to the circular skin edge, anchoring the former in place by four quadrant subcutaneous sutures.

CASE REPORTS

CASE 1. J. E., age, 30. The history of this case dated back to an operation, which was apparently a perineal lithotomy, performed 8 years before admission. Since that date there had been passage of gas *per urethram* and urine *per rectum*. On account of a damaged internal vesical sphincter, patient was able to retain only small amounts of urine in the bladder, and this only when in a recumbent position. To complicate matters further, there was a communicating perineal fistula through which about one-half of the urine drained. Patient stated that there had been eight previous operative

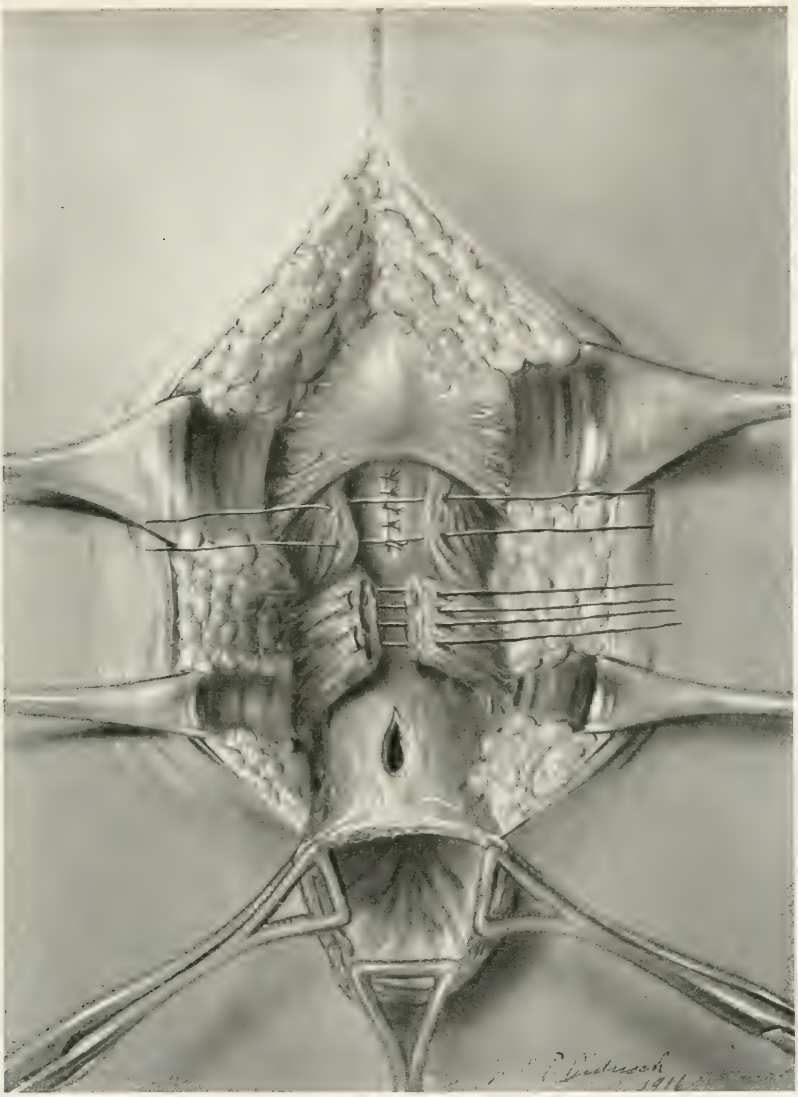

Fig. 6. After freshening its edges, the fistulous opening in the urethra is closed and the perineal musculature is brought together with interrupted sutures. The cut edges of the sphincter ani are approximated.

attempts at closure. On account of prolonged suffering he had become an habitual user of morphine.

Examination showed a depressed, scarred perineum with a mid-line fistula. *Per rectum* there was palpable anteriorly an opening large enough to admit the finger tip, communicating with the urethra at the apex of the prostate. The edges of the opening were sharp and well-defined and densely infiltrated with scar tissue. Cystoscopy showed a dilated internal vesical sphincter, which permitted withdrawal of the cystoscope into the posterior urethra, allowing a view of the verumontanum and, still lower, the fistulous opening into the rectum. In the suprapubic region there was also the scar of a previous suprapubic cystostomy. In spite of the patient's prolonged illness and many operations his general physical condition was good.

Operation was performed on February 10, 1920. The suprapubic incision was complicated by the previous scar in this region and adherent peritoneum. The bladder was found to be about normal in appearance except that the internal vesical sphincter stood widely open so as to permit a view into the

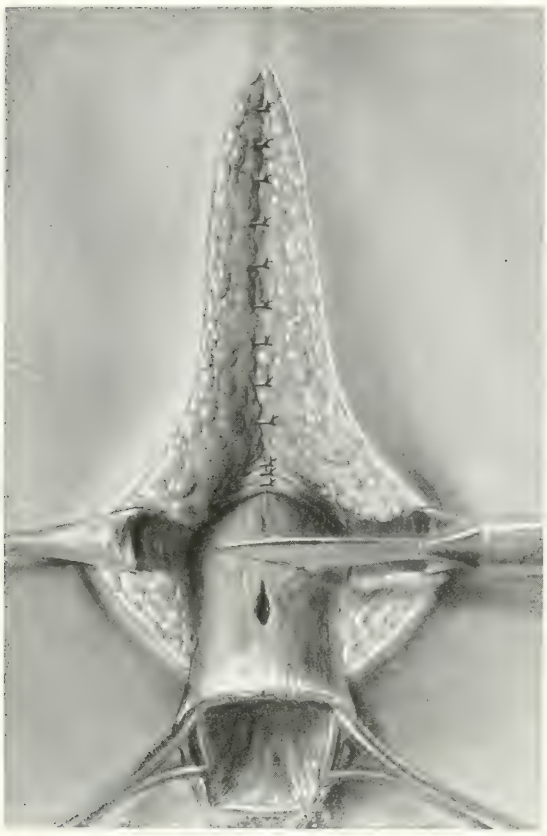

Fig. 7. The final stage of the operation consisting of the amputation of the cuff of mucosa containing the fistulous opening, after which the lower end of the rectal tube is united to the anal skin margin.

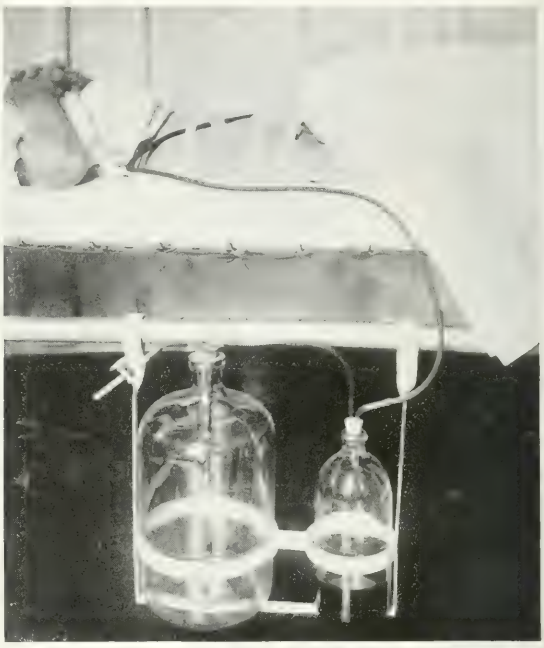

Fig. 8. Davis vacuum apparatus for maintaining suprapubic drainage. The larger bottle, the air from which is exhausted with a laboratory filter pump every 48 hours, maintains a very slight but constant suction within the urine bottle, through a minute communicating capillary tube. The amount of suction is regulated by an automatic mercury manometer. The bladder is kept empty, and the incision clean and dry.

posterior urethra. According to the technique described by Young (3), an incision was made posteriorly at the prostatic margin and two sutures of chromic catgut inserted so as to approximate the tissues in this region and close the relaxed orifice. The patient was then changed to the lithotomy position and the perineal dissection carried out. The opening in the rectum in this instance was so large that a soft rubber catheter, passed into the urethra, entered the rectum instead of the bladder. A great deal of difficulty was encountered on account of dense cicatricial tissue, both in the neighborhood of the fistulous opening and farther back between the prostate and rectum and firmly uniting these two structures. Of course, the cleavage plane normally offered by Denonvillier's fascia was obliterated and in peeling back the rectum it was necessary to take with it a small portion of the prostatic capsule. Closure was as described above. Patient left the table in good condition.

Convalescence was uneventful. Suprapubic drainage was maintained with the Davis vacuum drainage apparatus for 9 days, after which the tube was removed and the suprapubic fistula allowed to close. This took place after 4 days. The only complication worthy of note was an abscess which developed in the perineal suture line, which was opened on the fifth day and drained a small amount of pus. Following removal of the suprapubic tube patient voided normally, there being slight leakage of urine through the perineal wound for 3 or 4 days, after which this incision remained healed and dry. Sounds (26-F) were passed on the fourteenth day after which the patient was discharged from hospital.

Three months after operation a letter from the patient stated that he was voiding freely at normal intervals and had no incontinence of either urine or fæces.

Case 2. R. D., age, 32. Following an old neisserian infection, patient developed in 1919 what seems to have been an acute prostatitis, perhaps a prostatic abscess. A perineal operation was done for this condition, after which the patient was told that there had been no abscess but that it had been necessary to remove the prostate. Symptoms of a urethrorectal fistula appeared a few days afterward and this condition persisted in spite of two subsequent operations, one of which was a plastic opera-

tion which closed the openings both in the urethra and the rectum, and the other, simple division of the sphincter ani which resulted in directly uniting the rectum with a communicating perineal fistula. When first seen, patient was passing practically all of the urine through the perineal fistula.

Examination showed a markedly scarred perineum and a mid-line fistula just anterior to, and communicating with, the rectum. The sphincter ani was divided, causing partial incontinence of fæces. On rectal examination, the rectal fistula was not palpable as a hole, since all of the intervening tissue had been divided at the last operation.

Operation, April 3, 1920, did not differ essentially from the routine operation described above. Suprapubic cystostomy was first performed. The perineal dissection was complicated by the previous division of the sphincter ani and the involvement of the divided ends of this structure in dense scar tissue. The rectum and urethra were separated and it was found that the fistulous opening extended back about 1 centimeter into the prostatic urethra. Closure as above described. In uniting the divided ends of the sphincter ani, it was necessary to include scar tissue in the sutures and it was considered at the time that possibly the sphincter had been made a little too tight.

Convalescence was uneventful except for pain and discomfort caused by the suprapubic drainage tube which was removed on the ninth day. Following this, patient passed a good portion of the urine through the perineal incision. Perineal drainage, however, gradually diminished and ceased entirely at the end of 3 weeks. Suprapubic incision closed after 2 weeks. Sounds (26-F) were passed at the end of 3 weeks without difficulty.

When last seen, 6 months after operation, the perineal fistula was entirely dry and patient was voiding normally at normal intervals.

Case 3. J. S., age, 62. Patient's general health had been good up to the development of urinary difficulty in about 1917. Perineal prostatectomy was performed in December, 1919, followed by the development of a urethrorectal fistula.

Examination showed a perineum less scarred than the average. There was a small cummunicating perineal fistula through which about 50 per cent of the urine was voided. *Per rectum*, there was palpable a large communication between the rectum and membranous urethra, easily admitting the finger tip and extending back into the prostatic urethra. General condition good.

Operation, April 7, 1920, was performed according to the routine technique. After establishing suprapubic drainage, the perineal dissection was carried out in the routine manner. This dissection was somewhat easier in this case because the patient had had only one previous operation and the tissues were not as distorted as usual. The sphincter ani, which was entirely normal, was deliberately divided in the mid-line. The urethra was closed with interrupted sutures of chromic catgut and over this fibers of levator ani were united. The sphincter ani was repaired and final closure made as described above.

Convalescence was entirely uneventful. Following removal of the suprapubic drainage tube, there was no perineal leakage whatever, and the suprapubic incision closed within 2 days. Patient began voiding normally on the twelfth day and left the hospital on the fifteenth day.

Seen 6 months after operation, patient was voiding normally at normal intervals and was entirely well in every respect.

This paper is intended merely to emphasize the value of the Young-Stone operation, and does not include a summary of the previous literature. For this, and for a discussion of the various other methods, the reader is referred to the publications of Young and Stone.

Urethrorectal fistula is not a menace to life. Yet, the patient is almost totally incapacitated, particularly if his condition is complicated by a communicating perineal fistula, or by a damaged vesical or anal sphincter, which was the situation in 10 out of 14 cases. After months or even years of a miserable existence, barred from ordinary occupation, barred from society; and after two or three unsuccessful operative attempts, it is not strange that the patient should become depressed or mentally unbalanced. Two of the three here reported had contemplated suicide. Emphasis is here laid upon the serious condition of these patients, in reply to the possible criticism that the above operation is a very extensive surgical procedure, undertaken for the cure of a lesion which might seem relatively insignificant. The percentage of reported successful Young-Stone operations (93 per cent) is sufficient to justify a promise to the patient of a cure, with the ordinary reservations for surgical mishaps. The operation, then, offers a satisfactory *dependable* method of cure, which may be said of no other less radical procedure.

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SURGICAL TREATMENT OF SUPPURATION IN POSTERIOR MEDIASTINUM

Report of a Case[1]

By WILLIAM LERCHE, M.D., F.A.C.S., St. Paul, Minnesota

IN the literature there are reported but few cases of the type which is considered in this paper, that is cases in which suppuration originates in the neck and extends into the mediastinum and which are treated by drainage of the posterior mediastinum by the cervical route. The case presented below was operated upon in 1907. Up to that time we find but 8 cases reported in the literature, namely: two cases of von Hacker (1) 1901; and 6 cases that Hacker had collected (Luermann, 2, 1876; Ziembicki, 3, 1895; Obalinski, 4, 1896; Cavazzani, 5, 1899; Heidenhain, 6, 1899, and Rasumowski, 7, 1900). Gaudiani (8) published 2 cases in 1916. In Obalinski's case the abscess of the neck was incised, but no surgical treatment of the mediastinal suppuration was undertaken during the life of the patient. At postmortem, however, a posterior mediastinotomy was done. The case, therefore, should properly not be grouped here.

On August 26, 1907, I examined Mrs. R. T., age 50 years. She had had a dry catarrh of the nose and throat for many years. For 6 years preceding the examination, the patient had had a peculiar, hard, metallic cough, which frequently became paroxysmal in character. For about the same length of time she had had periodical attacks of dysphagia in which food would stick in the gullet, so that she had to force it down with liquids. There had been no regurgitation, but she had suffered severe pain behind the lower part of the sternum before food passed into the stomach.

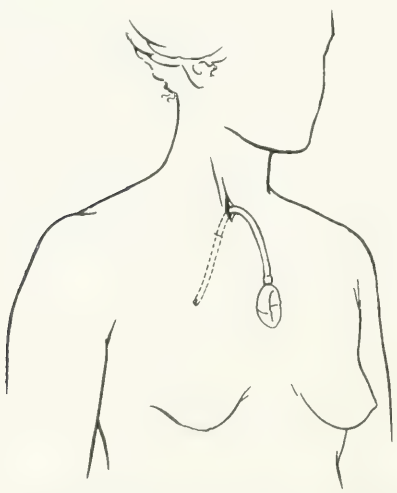

Fig. 1. Bulb attached to drainage tube which patient adjusted for suction.

In the last few months prior to the examination, the attacks had increased greatly in frequency and the last one had been of several weeks' duration. She had to limit herself to liquids and even those would cause much pain behind the sternum. She had lost 10 pounds in weight.

Examination showed an atrophic rhinitis, and the pharynx had a dry, glazed appearance.

The œsophagus was empty but somewhat dilated and the epicardia-cardia was seen in spasm in one of the three œsophagoscopies made. The cervical part of the œsophagus had the same dry, glazed appearance as the pharynx. The dysphagia and the spasms of the œsophagus gradually grew worse, and on October 5 the patient had a temperature of 102° and pulse 110, with swelling and tenderness of the lower right side of the neck. October 7 small quantities of pus were gulped up.

October 8 an incision was made 10 centimeters in length along the anterior border of the sternocleidomastoid muscle to the sternal notch. When the right lobe of the thyroid was retracted toward the mid-line, a large abscess cavity was disclosed behind it, between the œsophagus and the trachea on the inner side and the sternocleidomastoid muscle and the large vessels on the outer side.

The abscess could be followed into the superior and posterior mediastinum for about 9 to 10 centimeters below the top of the sternum. A rubber drainage tube was left in the mediastinum, the rest of the abscess cavity packed with iodoform gauze, and the patient put to bed in Trendelenburg's position. The following day a siphon drain was arranged with the patient in the horizontal position. Later a soft rubber bulb (Fig. 1) was attached to the drainage tube, which the patient now and then adjusted for suction. The wound healed in 7 weeks.

Although there were small quantities of pus gulped up the day before the operation, there was at no time any evidence of œsophageal fistula.

The etiology of the case is of interest. The peculiar cough and periodically recurring attacks of dysphagia of 6 years' standing, the

Read before the American Association for Thoracic Surgery, New Orleans, May 1, 1920.

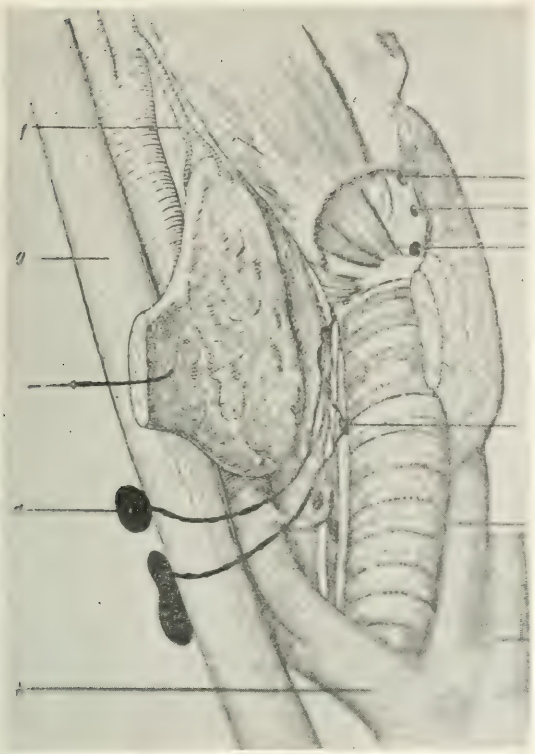

Fig. 2. *c*, Lymph nodes of recurrent chain. *d*, Lymph nodes of external jugular chain. (After *Rouband.*)

Fig. 3. Roentgenogram of cadaver showing extension of barium injection into upper part of groove between œsophagus and trachea.

increasing severity of symptoms in the 3 to 4 months preceding the operation, with the final formation of the large abscess, followed by complete cure, without the slightest return of any laryngeal or œsophageal symptoms, in the thirteen and a half years following the operation, suggest a local nerve irritation. The explanation is probably that the right recurrent chain of lymph nodes (Fig. 2) had become infected and caused irritation of the recurrent laryngeal nerve, situated in the groove between the trachea and œsophagus, supplying the larynx and sending twigs to the trachea and the œsophagus.

The recurrent chain of lymph nodes receive the lymph trunks that drain the upper end of the œsophagus, and the already chronically inflamed mucosa of the upper end of the œsophagus was probably the avenue of entrance of the infection.

In several of the reported cases the pus was found in the retro-œsophageal space, extending into the posterior mediastinum. In my case the pus was not retro-œsophageal, it probably followed the groove between the œsophagus and trachea. However, no mention was made in my record of the exact point of entrance.

In order to get information about the probable route taken by a liquid mass introduced into the upper part of the groove between the œsophagus and trachea, I injected into that area in fresh cadavers, barium suspended in buttermilk. With moderate, gradually increasing force, the liquid mass was found to extend laterally along the œsophagus and trachea into the superior mediastinum, extending a few centimeters below the tracheal bifurcation into the posterior mediastinum. It also followed the vessels, and when greater force was used, it crossed in front of the trachea to the opposite side. Roentgenograms were taken (Fig. 3).

It may be of interest to mention here that in dressing the patient, I repeatedly intro-

duced an endoscopic tube into the mediastinum, and, while the patient swallowed milk I observed the rapid peristaltic wave of the œsophagus.

The number of cases thus far operated upon (including that of the writer's) is 10, 6 of which made complete recovery after cervical mediastinotomy. In one case, that of Cavazzani, dorsal mediastinotomy was added after 3 months of drainage by the cervical route.

Three out of the ten cases died. In view of this, the dictum of Ziembicki, that every case should be drained both by the dorsal as well as the cervical route, can hardly be accepted. If, however, cervical mediastinotomy should prove insufficient, it should be supplemented by dorsal drainage.

Several methods of approach in dorsal mediastinotomy have been described. The difference in the various operations consist mainly in the placing of the incision or the flap, and in the treatment of the ribs, the object in all being to separate the pleura from the ribs and vertebral column in order to gain access to the posterior mediastinum. Nassilow, Quénu and Hartmann, Rehn, Bryant, and others placed the incisions at some distance from the mid-line with more or less extensive resection of ribs, while Heidenhain's incision is close to the mid-line. He separates the fibers of the thick muscle layer and resects one or more transverse processes with a small part of the attached rib. If more space is needed, a cross incision may be added. I have performed this operation on the cadaver, and, as there is probably less liability of tearing the pleura, the Heidenhain operation would perhaps be the one of choice in the draining of the mediastinal abscess.

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THE DIFFERENTIATION OF SAPHENOUS VARIX FROM FEMORAL HERNIA

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IT is well known that the not uncommon dilatation of the terminal portion of the saphenous vein near its entrance into the femoral is frequently mistaken for a femoral hernia. This dilatation is sometimes found of considerable size and, when the patient is standing, may easily be seen as a protruding mass in approximately the location of a hernia through the femoral canal (Fig. 1). It is often painful and symptomatically very readily suggests such a hernia.

De Quervain (1) passes over the diagnostic difficulties rather lightly and concludes that a confusion between the two conditions is almost unthinkable. The main points of differentiation according to this author are, in the case of saphenous varix, a bluish sheen to the skin over the swelling, easy compressibility and prompt reappearance upon release of pressure, and fluctuation in size with every change in the venous pressure from coughing, vomiting, and even lying down or normal breathing.

In spite of the clarity of these directions and the apparent simplicity of diagnosis, these aneurismal dilatations of the upper part of the saphenous vein are regularly diagnosed and operated on as femoral herniæ, even by very careful observers. The bluish appearance is absent if the subcutaneous fat is at all pronounced. The compressibility is often just as marked in a hernia. The enlargement with the increase in venous pressure as in coughing, or the disappearance on lying down, are not very unlike the hernial impulse on straining, on the one hand, and the spontaneous reduction of the rupture in the recumbent position, on the other. I have seen a number of these cases in which either the error in diagnosis was deliberately made or where the diagnosis was doubtful until the lesion was exposed at operation. Some years ago Coppernail (2) reported a case in a woman who had what had been regarded as a reducible, right femoral hernia for 20 years. The mass suddenly became painful and irreducible. Accompanying this change, there was repeated vomiting of a fœtid character, obstipation, and tympanites. A diagnosis of strangulated femoral hernia was promptly made, and an immediate operation performed. The apparent strangulated femoral hernia turned out to be a thrombosed saphenous varix.

Quite recently I was consulted regarding a case of so-called recurrent, left, femoral hernia, which had been operated on some months previously. The sac had not been found, but a careful plastic by the Lotheisen method had been done. A recurrence was noted almost as soon as the patient got out of bed. Re-operation for the hernia had been advised and was about to be carried out when I saw the patient. The diagnosis was made of a saphenous varix, which I excised (Fig 2).

In addition to those signs mentioned by De Quervain and referred to above, there are a few points in the differentiation of these two conditions, which I believe might aid in the diagnosis.

The position of the swelling in the dilatation of the upper part of the saphenous vein is usually somewhat lower down than in the case of a femoral hernia. This dilatation, while it may be at the saphenous opening, just at the entrance of the internal saphenous into the femoral vein, is generally a centimeter or two below the junction. In the case from which the specimen illustrated was taken, there was an interval of nearly 2 centimeters between the sacculation and the opening into the femoral.

As a rule other varicose veins will be found on the leg and thigh if a dilatation exists near the saphenous opening. When the patient stands, the internal saphenous vein itself is generally very evident as a distended vessel running between the inner posterior aspect of the knee to the aneurismal sac.

Fig. 1. Case of saphenous varix simulating femoral hernia.

Fig. 2. Specimen from case of saphenous varix, which had been diagnosed and operated upon as a femoral hernia. Re-operation for recurrence had been advised.

Reduction of the tumor and pressure over the femoral ring by the examining finger does not hold back a saphenous varix which reappears if the patient strains or stands. Finally the impulse on coughing differs materially in the two conditions. Instead of a frank impulse as in a hernia, there is, in the venous dilatation, a fluid wave or thrill. This is readily elicited if only light pressure is made during the examination. This last sign is almost pathognomonic. It can be simulated in hernia only if there is a coexistent ascites, which is readily recognized. Coley (3), in his article on hernia in Keen's *Surgery*, also emphasizes the last three mentioned differential points, namely: in saphenous varix, the presence of other varicose veins, the recurrence of the swelling even when the hernial orifice is compressed, and the fluid thrill as distinguished from the hernial impulse on coughing.

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RECONSTRUCTION OF THE HAND

A New Technique in Tenoplasty

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IN THE treatment of traumatisms and infections which impair function, from an industrial and wage earning standpoint, it will be granted that the hand comes next in importance to the brain and eye (Fig. 1). It was with this thought in mind that the present investigation and research were instituted in an endeavor to better, if possible, the technique involved in the restoration of the function of the hand. Such restoration includes, of course, lesions of the fingers, hand, wrist, and forearm, and involves changes in the skin, fascia, palmar spaces, bursæ, nerves, bones, articulations, ligaments, muscles, or tendons or all of these.

The chief factors which produce impairment of function in the hand are infections, penetrating wounds, and deep burns. To this list must be added operative traumatism, as every surgeon of experience has encountered cases in which the most scrupulous and apparently aseptic technique has been observed and primary healing has followed, but as an end-result, adhesions have formed or contractures occurred from operative traumatism, which vitiated perfect restoration (Fig. 2).

In a paper of this scope, it is not possible to cover the detailed treatment of each of these disabilities, except by a brief reference to the mode of procedure employed in certain cited cases. Chief attention will be paid to lost function in the tendons.

Even from the standpoint of restoration of function in the tendons, much depends upon the previously correct diagnosis of the original lesion and initial treatment or maltreatment. Many seriously deformed hands from lacerations and infections are the result of needless incisions in the wrong place or dilatory incisions in the right place. In some of such cases, perfect functional restoration is next to impossible. It, therefore, follows that much restoration later may be avoided, if the original treatment is on scientific lines. A correct knowledge of proper early treatment of the various affections and injuries to this member is pointed out in Kanavel's *Infections of the Hand*, that valuable and useful book to all who are called on to do accident surgery of the upper extremity. Thus a hand or forearm presenting a lymphangitis must be treated entirely differently from a tenosynovitis and so must fascial space and bursal infection. As Kanavel says:

"The location of the greatest swelling comes in those areas where there is the largest amount of loose cellular tissue, i.e., upon the dorsum, while in nine cases out of ten the pus is on the flexor surface.

"The site of the greatest tenderness is of marked importance in the location of the pus.

"The treatment of the three types is essentially different and the gravest error will be made, if they are not differentiated, since their treatment is diametrically opposed."

Briefly stated:

a. Lymphangitis shows little locally except at the site of the invasion and streaks along the lymphatics on the *dorsum* of the hand and forearm, but, is manifested chiefly systemically by the fever and malaise of infection. Indiscrimate incision in such cases is not only not indicated, but positively harmful. Hot dressings, preferably saturated with boric solution, rest of the part locally, and systematic elimination must be relied on chiefly, until the acute symptoms subside.

b. Tenosynovitis is shown by exquisite tenderness over the *course* of the sheath and limited to the sheath and increased pain on extension, especially proximally. In such cases under *general anæsthesia*, preferably nitrous oxide and oxygen, and *in a bloodless field* the tendon sheaths should be freely opened *laterally, not centrally*, with care to preserve so far as possible the fascial sheaths that act as pulleys at the flexures of the fingers, and should be dressed with vaseline gauze.

Fig. 1. Both hands rendered useless by destruction of carpus, ankylosis, and binding down of tendons in scar tissue.

c. Palmar, thenal, and hypothenal space infections and radial and ulnar bursal involvement, often secondary to neglected tenosynovitis, should be carefully differentiated and freely incised in the proper location to secure maximum drainage and avoid vessels and nerves. Kanavel recommends the continuance of the bloodless bandage after operation, sufficiently tight to produce passive congestion for 24 hours, and thus allow slow absorption of toxins.

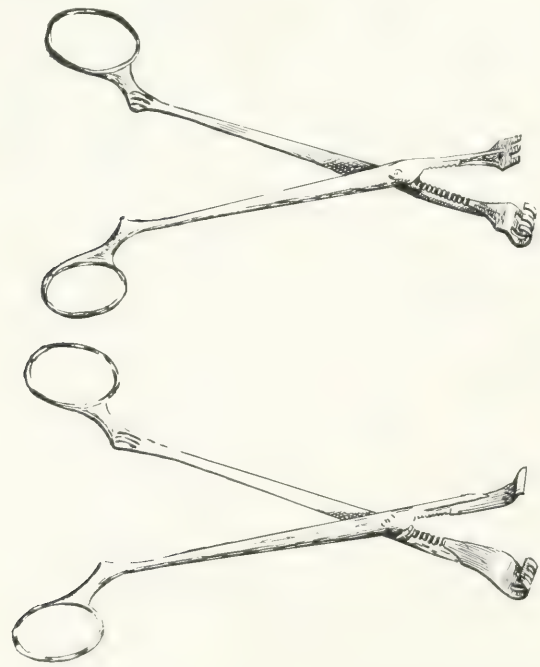

Fig. 3 (above). The second instrument devised as a tendon clamp, by the author.
Fig. 4. The third type of tendon clamp devised.

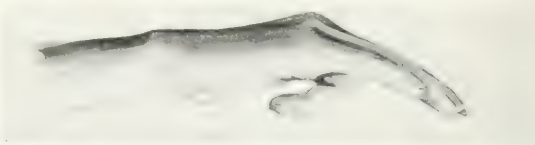

Fig. 2. Contracture of finger following "traumatic surgery," which resulted in adhesion in tendon sheath.

Too great conservatism is as dangerous in early treatment as radical indiscriminate surgery, for the reason that in the former, undue delay permits extension of the infection from one region to the other, as the latter may cause unnecessary infection and destruction of tissue or function in opening up uninvolved areas. A good rule is to be sure of the chief and primary location of pus, incise and follow up its extension to other spaces and bursæ by additional incisions to secure free drainage, if necessary.

As pointed out by Willmes, early passive and active use will help to force pus out of adequate incisions and promote return of function. The surgeon with gloved hand may accomplish this manipulation with less pain to the patient, if the latter's hand is immersed in hot water.

Unfortunately, many cases presenting themselves to the reconstructing surgeon are samples of previously bad jobs with not only ruthless disregard to ultimate function, but evidence of ignorance of anatomical pathology.

In addition to this, some reconstruction with an aim at functional restoration is marred by what may be termed traumatic surgery or what has been previously spoken of as "operative traumatism." By this is meant the unnecessary wounding of tendon structures during operation, drying out, having the skin incision directly over the line of repair of a tendon-sheath or tendon, leading to adhesions and contractures, so as to vitiate *partially or wholly* the entire operative procedure, just as surely as a break in an aseptic technique with infection would.

PREPARATION FOR TENDON OPERATIONS ON THE HAND OR FOOT

The writer has had more perfect results in tenoplasty by resorting to the old method, rather than by the popular and generally

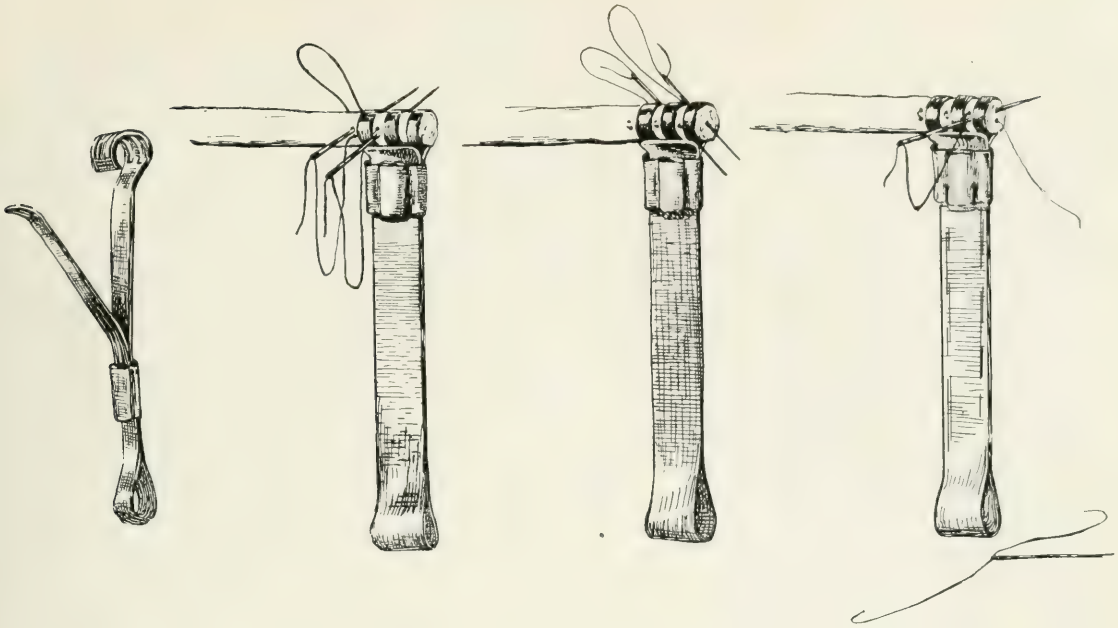

Fig. 5. Fig. 6. Fig. 7. Fig. 8.

Fig. 5. The author's accepted type of clamp made of clock spring.

Fig. 6. Silk threaded in two needles showing transfixation of tendon to left of clamp. After the thread is passed obliquely on its return from the far side back to the near side in the first fenestrum, it is passed obliquely to the far side in the second fenestrum. (The writer's technique.)

Fig. 7. Needle passing from the far side of the second fenestrum to the end of the tendon.

Fig. 8. The second needle passing from the near side of the second fenestrum through the end of the tendon.

used iodine and alcohol method of skin sterilization.

The older method referred to is the preparation 24 hours in advance of the operation, *i.e.*: (1) green soap scrub and shave; (2) application in turn of (a) permanganate of potassium solution (3 : 100), (b) oxalic acid solution (3 : 100), (c) ether, (d) alcohol, (e) bichloride of mercury (1 : 5,000) solution, applied on wet towels from finger tips to axilla until patient is etherized and operator is ready to begin.

BLOODLESS FIELD

It is hardly necessary to mention that this work should be done in a bloodless field to secure clear recognition of the parts and to avoid the necessity of sponging, which, if required, should be done with *moist absorbent cotton* and *not wiped with gauze*. After applying the rubber bandage with uniform firm pressure from the hand to the elbow, the round U. S. Army constrictor should be applied by four turns, making a wide band above the internal condyle of the humerus which region is covered by a gauze handkerchief to protect the ulnar nerve. With this technique, danger of pressure paralysis is remote and almost negligible.

Skin incision should not be over the point of the desired tendinous union. As previously stated, a crescentic or semi-circular flap should be dissected back at the beginning of the operation, so that the point of tendinous

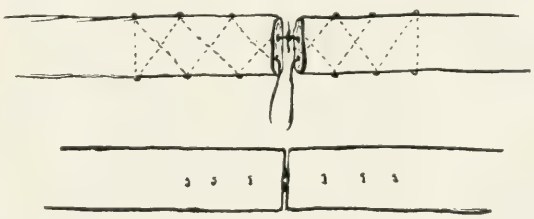

Fig. 9. Above, diagram shows the course of the silk through the tendons and end-to-end tying. Below, lateral view of end-to-end approximation of tendons. Dots of silk are the only evidence of this method of suturing.

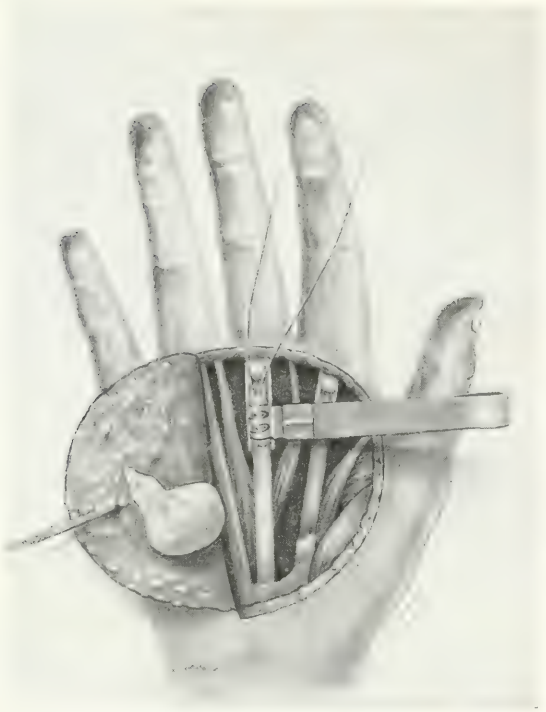

Fig. 10. Tendon clamp applied to the sublimis of the third finger of the right hand. Suture *in situ* and ready for transplantation. On the left is shown the wet pledget of cotton, which, in practice, is spread over the tendons except at the point where work is actually being done, to prevent drying out of the tendons. The sheath of the sublimis is shown attached to distal end of severed tendon.

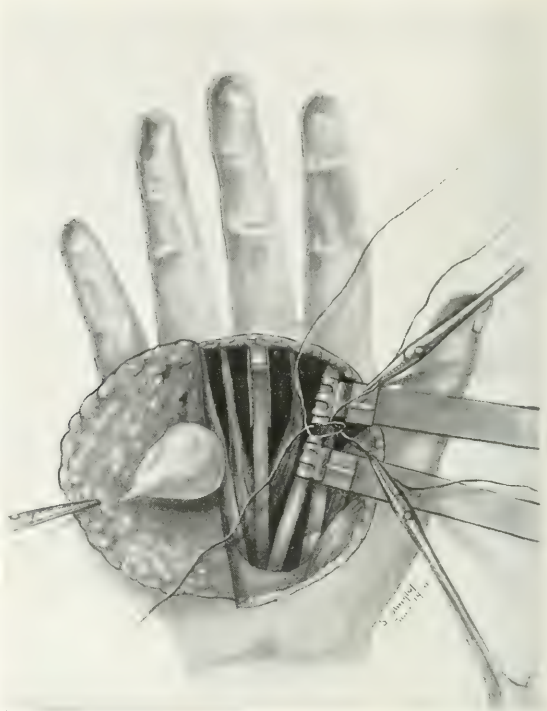

Fig. 11. The proximal end of the sublimis tendon with suture *in situ* is here shown approximated to the distal end of the profundus tendon of the index finger by means of the tendon clamps as instrumental knotting of the silk sutures is effected. As in Fig. 10 the wet cotton is here also gathered in a mass as otherwise it would obscure the relationship of the parts.

union should not lie under the line of suture of the skin for fear of being caught in the skin scar and interfering with ultimate function.

PROTECTION OF FIELD OF WORK FROM DRYING DURING EXPOSURE

Soon after the tendons in question are exposed, bits of absorbent cotton wet in a bowl of normal salt solution should cover the field of work as far as possible to keep the tissues moist.

Sterling Bunnell[1], of San Francisco, applied the term "atraumatic technique" to tenoplasty in sewing tendons end-to-end and devised an instrument of thin metal which might be wrapped around the tendon's end to facilitate handling and not traumatize, as rat-tooth or mouse-tooth forceps or even a hæmostat would, if the tendon during the operative procedure was held by it. Bunnell's tendon clamp consists of two parts and really three procedures are involved in its application. One piece, a strip containing two fenestra in the center, first is folded over the tendon and held in place; second, a slide of the same metal like the sliding keeper of a belt to hold the tendon securely in the strip, is put on. The slide is then held in place by a hæmostat as the third procedure. It has seemed to the writer that in a large number of cases these three procedures would be greatly facilitated by the use of one instrument fenestrated for suturing and for grasping without traumatism, and entail the possibly unsurgical manual handling of the tendon, which procedure is especially dainty, tedious, and time-consuming in applying the minute slide over the two ends of the tendon-holding strip of thin metal now doubled over the tendon.

[1] Surg., Gynec. & Obst., 1918, xxviii, 103-110.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 12. Diagrammatic drawing of the tendons of the hand showing the sublimis tendons cut across and removed from the palm and the profundus tendons exposed.

Fig. 13. Diagrammatic drawing of the back of the hand showing that there are normally two extensor tendons attached to the first, second, and fifth fingers.

Fig. 14. Cook's method of utilizing extensor tendon of little finger to effect flexion and adduction of thumb.

THE NEW INSTRUMENTS

Accordingly, the writer had pieces of equal size of thin, flat German silver soldered on the ends of minute mosquito hæmostats and curved in varying degrees to grasp tendons of varying sizes, and dentated so that when closed centrally the intervals between the dentates would become fenestra through which sutures could be passed. These instruments after repeated use demonstrated that the very thin metal would bend and prevent close central approximation of the dentates and would cause the suture material, fine intestinal silk, to catch on the projecting dentates.

The next instrument devised was a dentated crook-like piece made of steel attached to one blade of the mosquito clamp with a trident on the other to coapt laterally and not centrally. Sutures were more readily applied with this, but still, silk occasionally caught and retarded the operative procedure (Fig. 3).

Next, a similar crook-like instrument was made with fenestra, but with a straight edge of contact with the smaller blade and no dentations. It was found the crook-like portion could be instantly put around the tendon just as a blunt retractor is placed in tissues, the instrument closed, and the slippery tendon then held firmly while the sutures were inserted (Fig. 4). This instrument was most satisfactory, but with a desire to have as small an instrument as possible, especially such as is sometimes required in the palm of a flexed hand, the hæmostat type was discarded for the final type shown (Fig. 5), made of clock spring with a slide lock but with the same fenestrated blunt retractor-like end. This has been entirely satisfactory.

The writer has found three sets, of two each of these, useful for tendons of the hand, varying in sizes of two, four, or six millimeters in diameter. The retractor-like blade is 10 millimeters wide and the fenestra are 2 millimeters wide to allow the easy, oblique passage of a straight cambric needle. The whole instrument is about 10 centimeters long.

NEW TECHNIQUE IN APPLYING SUTURES

With the new instrument it was found possible to work out a *new technique* whereby a more perfect application of the fine silk approximation of stay sutures might be put in, leaving a *minimum of silk exposed* to prevent

Fig. 15 (above). Patient unable to flex the adductors of the thumb before operation.
Fig. 16. Same patient after the Cook operation.

Fig. 17. Roentgenogram of patient with severed flexor tendons of the index finger and partial destruction of the metacarpophalangeal joint.

the production of possible *traumatic adhesion* from the silk.

This method consists of threading a fine straight cambric needle on each end of fine intestinal silk of suitable length. With the tendon clamp applied as close to the end of the cleanly severed end of the tendon as possible, the first needle transfixes the tendon just beyond the clamp straight through and it immediately transfixes the tendon obliquely,

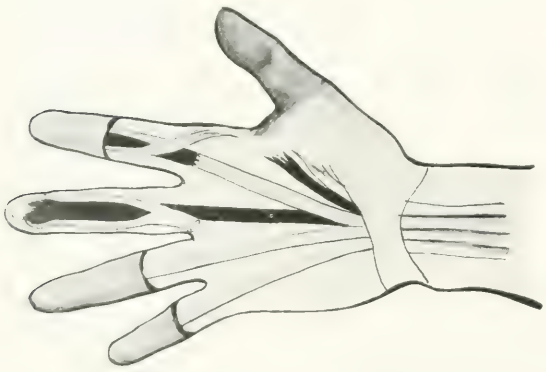

Fig. 18. Diagrammatic representation of the condition shown in Fig. 17 and transferring the sublimis tendon of the third finger to the profundus of the index finger.

coming out of the first fenestrum on the *near side;* then it immediately transfixes the tendon obliquely coming out the second fenestrum of the *far side*, and finally transfixes the tendon obliquely, coming out the free end of the tendon when the first needle is removed. Now, with the second needle the same sort of procedure is carried out, only in the reverse direction, coming out obliquely in the first fenestrum on the *far side*, then the second on the *near side*, and, finally, the opposite side of the free end of the tendon (Figures 6, 7, and 8). Thus it will be seen that there remains none of the silk exposed on the side of the tendon, except small dots. When a similar arrangement of sutures is placed in the other tendon, the four silk strands may be tied closely, approximating the severed ends end-to-end by double surgeon's knots and the excess of silk cut away, so that these knots are entirely buried between the cut ends of the tendons (Figure 9).

PROTECTION OF POINT OF UNION BY FAT

Small sheets of fascia and fat should be dissected from the subcutaneous tissues adjacent and wrapped around the point of

Fig. 19 (above). Condition of this patient before operation.

Fig. 20. The power of picking up small objects after operation.

Fig. 21. Roentgenogram of patient showing destruction of first interphalangeal joint of the third finger.

union in order to prevent further adhesion, so far as possible.

Figures 10 and 11 show the application of the new tendon clamps in operative tendon transplantation of the flexor sublimis digitorum from the middle finger to the flexor profundus digitorum of the index finger. The crescentic flap is shown as is also the moist cotton to prevent drying during the operative technique and the application and tying of sutures.

REVIEW OF TENDINOUS ARRANGEMENT IN THE HAND

It will be recalled that on the palmar aspect each finger has two flexor tendons, a superficial and a deep. Of these, the superficial is chiefly concerned in flexing the first phalanx at the metacarpophalangeal joint on the corresponding metacarpal bone, while the deep flexor has for its chief function not only the flexion of the first phalanx on the corresponding metacarpal bone, but the phalanges on each other. Therefore, if we are to depend on one only, the deep flexor alone will give us more function than the superficial flexor alone and if in the palm of the hand both flexors have been severed or bound down in scar tissue, we will naturally attach a transplanted tendon to the distal end of the remaining stump of the injured profundus. Further, in choosing a tendon to transplant and take the place of the one destroyed, we will naturally select or steal the sublimis, as we will thereby interfere to a less degree with the remaining function of the finger from which the theft is made, than if we had stolen the profundus. Figure 12 shows the sublimis tendons cut away proximally and distally in the palm to expose the underlying profundus tendons.

Passing now to the dorsal aspect, we find the thumb, index, and little fingers supplied

Fig. 22. Diagrammatic representation of the destruction of the profundus tendons in both the third and the fourth fingers, also the destruction of the sublimis in the fourth, being the condition accompanying the joint destruction shown in Figure 21. There is also shown the transferring of the sublimis of the second to the profundus of the third and the sublimis tendon of the third to the profundus tendon of the fourth.

Fig. 23. At left, condition of this patient before operation, unable to grasp objects. At right, the grasp restored after operation.

with more than one extensor tendon, so that with care in selection to accomplish greater efficiency in general manual function, a tendon from one of these may be stolen (Fig. 13).

It will be found also in making a transplantation from the palmar surface to the dorsum for paralysis or other loss of extensor function, it is better to make the transplantation to one tendon, rather than suture to a group, for the reason that the application of force in one direction will yield greater precision, than if it is split up in several directions. For example, suture to all the extensor tendons of the fingers, is not as satisfactory as suture to the extensor of the middle finger for simple wrist drop. If, however, the wrist drop occurs chiefly to the ulnar side from underaction of the extensor carpi radialis longior, it would be more efficient and more correct mechanically to make our transplant to one of the extensors of the index finger or the thumb, etc.

Further, in the experience of the writer, it is necessary to attach our tendons *under* tension, to allow for stretching, to hold the part in rather *extreme overcorrection* when sutured, whether our transplant is attached to bone, periosteum or tendon to tendon, but Mayer[1] and some others dissent from this view and hold that the natural tonicity of the muscles will provide for this. When, however, we consider possible changes in the articulations and bones according to Wolff's law in deformity, another justification is found for

[1] Biesalski and Mayer. Die physiologische Sehnenverpflanzung Berlin: 1916.

Fig. 24. Roentgenogram shows the patient with destruction and non-union of third metacarpal.

Fig. 25. Roentgenogram shows sliding bone-graft obtained from distal segment to restore bone continuity.

overcorrection entirely to correct deformity, as frequently in deformities we are not dealing with soft parts alone, but bones as well.

APPLICATION

CASE 1. A strong, vigorous girl otherwise, had had frequent recurrent attacks of backward dislocation of the right thumb at the metacarpophalangeal joint from underaction or elongation of the flexor longus pollicis. This recurrence had persisted for about two years and with each attack, which upon application for treatment was of daily occurrence and followed by pain and aching up the arm. It was a painful manifestation of what is usually called a "double-jointed stunt" in boys and a source of gratification to the performer and envy to his playmates. This patient, however, had the condition only in the thumb and it was a source of extreme discomfort to her, interfering with her daily ordinary and routine pursuits and piano lessons. It was not possible to trace any given traumatism in endeavoring to establish its etiology. Being the right thumb added to her difficulties, as she was normally right handed and called upon to use it more than the left. Months of so-called conservative treatment with adhesive strapping, leather appliances with elastic bands to permit flexion from 30° to full flexion but to prevent any extension whatever, failed to afford a shortening up of the flexors to prevent recurrence and relief. An elliptical incision was made so that the flexor longus pollicis came to lie under the center of the flap and in the transverse plane of the metacarpophalangeal joint of the right thumb; the tendon sheath and radial bursa were opened and the tendon grasped by the tendon holders placed half an inch apart. To prevent drying out, bits of absorbent cotton moistened with salt solution were placed beside the exposed area. The intervening tendon was then cut transversely across with a sharp scalpel at the adjacent margin of each tendon clamp, thereby shortening the tendon by half an inch. Buried sutures were inserted in the manner above described and by flexing the thumb close, approximation end-to-end with buried knots was obtained, when the sutures were tied. A small sheet of fat and fascia was dissected free from the inside of the skin flap and placed around the point of union. The edges of the sheath of radial bursa were restored to their proper position, but not sutured. The skin was sutured with fine interrupted silk sutures. Silver foil and tissue paper covered the incision and a gauze handkerchief was placed under the thumb and in the palm, and over suitable dressing, adhesive plaster and a snug plaster-of-Paris bandage held the thumb flexed. On the eighth day the skin sutures were removed, as the skin wound was found entirely healed and the dressings re-applied to hold the thumb in the flexed position, which was maintained for 4 weeks, when after a brief course of massage and resistive exercises in flexion, full function was established and no recurrence of the disability has returned.

Fig. 26. Roentgenogram shows non-union of third metacarpal.

Fig. 27. Autogenous bone-graft obtained from the tibia shown.

Fig. 28. Roentgenogram showing destruction of portion of radius and soft parts, with bone graft (tibia) *in situ*.

Case 2. A soldier, who had been shot through the left hand in the cleft between the thumb and the index finger, was operated on by Robert J. Cook, of my service, by the very ingenious method devised by him, as this man could not produce the opponens power in the thumb, which was held in extreme extension and abduction. Doctor Cook utilized the extensor minimi digiti, which he freed at the first phalanx of the fifth finger through a small incision and through a second incision above the styloid process of the ulna on the dorsum of the wrist located this tendon, drew it out of its sheath, passed it through the subcutaneous fat around to the palmar side to an anterolateral incision on the distal end of the metacarpal bone of the thumb, through which he passed the tendon and sutured it to itself under tension as shown in the diagram, while the thumb was held in the opponens position. The three incisions were closed and the fixation and after-treatment were similar to that used in Case 1. The man made an uninterrupted recovery of function, as shown in Figures 14, 15, and 16.

Case 3. A soldier had been shot through the right index finger at the proximal end of the first phalanx, as shown in the X-ray and at the same time both flexor tendons were severed and their proximal ends were bound down by scar tissue in the thenal space, but the stump of the profundus at the first phalanx was identified and freed. After rounding off the jagged end of the phalanx and interposing free fat and fascia in the joint, the sublimis tendon of the middle finger was sutured end-to-end with the profundus distally. This case had complete restoration of flexor function so minute as to permit picking up a pin, as shown in Fig. 20.

Case 4. A soldier had been hit by a piece of shrapnel in the palm of the right hand, severing the profundus tendon of the middle finger, both flexors of the ring finger and also shattering the first interphalangeal joint of the middle finger, so that this patient could not make a fist nor grasp a rod. The articulation was restored as in the preceding case and the sublimis tendon of the index finger given to the profundus of the middle finger and the sublimis of the middle finger given to the profundus of the ring finger (Figs. 21 and 22).

Fig. 29 (above). Skin flap obtained from abdomen (whole thickness).

Fig. 30. Arm prior to skin grafting.

As a result of these procedures, this patient was restored as shown in Figure 23: *a*, before operation; and *b*, after operation.

Case 5. Patient was shot through the palm of the hand, the tendons escaping, but the middle third of the third metacarpal was shot away and union had not occurred and the hand was very weak (Figs. 24 and 25). Sufficient bone was left in the distal fragment to permit securing of a *sliding bone-graft*, which was done with satisfactory results.

Case 6. This patient was shot also through the palm of the hand at the junction of the middle and distal third metacarpal bone without much loss of substance but with no tendency to union and with much loss of power in the grasp. The tendons were not affected except so far as the mechanics of the hand lessened their efficiency (Figs. 26 and 27). A small bit of bone was removed from the tibia and an *autogenous inlay and spike-graft* was put in the proximal and distal fragments respectively, with union and restoration of power and function.

Case 7. A girl, 7 years old, was sent to the corner store in mid-winter to get a can of gasoline. On her way home, she stumped her toe and spattered a large quantity of gasoline over her dress. On reaching home, she went to the kitchen range to warm herself, as she was chilled from the low temperature outside and the evaporating gasoline. Immediately her dress was in flames and she was deeply burned on the left hand, arm, left side of face and ear. On admission, dense scar formation permitted only slight movement at the axilla, elbow held flexed 110°, and the hand was a typical *main en griffe* with flexed wrist and fingers, the tips of several of the latter having sloughed off. After removing the scar, a pedicle whole thickness flap from the back restored the skin of the axilla and by means later, of a sliding flap, the elbow was restored. Finally, by means of a whole thickness skin graft, skin was obtained from the abdominal wall and a new palm and

Fig. 31. Whirlpool arm bath.

palmar surface of the wrist-joint was made leaving the pedicle attached to the abdomen two weeks. This was then cut away and the remaining sutures applied with restoration of function at the wrist-joint. Subsequently massage and a "cock-up" splint produced a much more presentable and useful hand.

Case 8. This patient was shot through the lower third of the radius, carrying a large part of the bone, tendons, and skin away, as is shown in Figures 28 to 30. This had to be restored in the order of skin, bone, and tendons, which was accomplished as shown in the illustrations.

The above cases represent the types most commonly met with.

AFTER-TREATMENT

Many of these cases show marked stiffness after anatomic or functional restoration and require more or less prolonged after-care and attention to secure the maximum efficiency obtainable. Much of the success secured in these cases should be attributed to the physiotherapist as well as to the surgeon. The use of hydrotherapy in the warm or hot "whirlpool" is an excellent preparation for manipulative treatment with progressively increasing passive, active, and resistive movements either in or out of the water, and later massage and Bristow surging faradism (Fig. 31).

Much stiffness is often found in old traumatic and paralytic hands with wrist drop

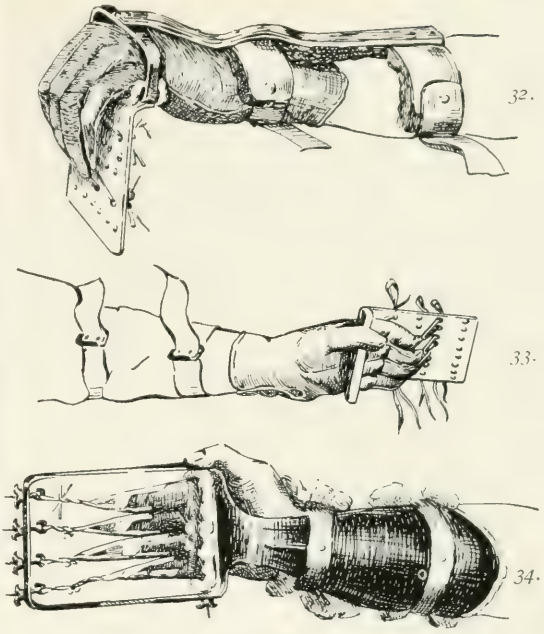

Fig. 32. Skirball's splint. Palmar application.
Fig. 33. Skirball's splint. Dorsal application.
Fig. 34. Lewis splint.

and flexed fingers and those cases showing marked tightening up of the ligaments at the metacarpophalangeal joints so that in the interim between physiotherapeutic treatments the parts may be continually stretched and recontracture prevented. This may be accomplished by suitable splints. I have found the Skirball and Lewis splints most useful.

The former was devised by Louis I. Skirball, of Boston, formerly of my service, and is made of aluminum and is very light in weight. It consists of a perforated square palmar or dorsal plate, a ring around and just below the metacarpophalangeal joint and bands at the carpus and upper forearm with straps, padded where necessary with felt. A heavy walking glove is placed on the hand with strong tapes at the distal end of each phalanx of the glove on the palmar or dorsal aspect as the case may require so that these tapes may be passed through the perforations and tied as tightly as possible to maintain the correction. The perforated plate also may be bent in any desired form in the brace shop (Figs. 32 and 33).

The Lewis splint consists of the regulation "cock-up" palmar and forearm splint plus a movable rectangular quadrangle extending 2 to 3 inches beyond the finger tips. This quadrangle is attached to the "cock-up" just proximal to the heads of the metacarpal bones and fixed at any angle of flexion that may be desired by two lateral thumb nuts. On each finger at fault is fastened surgeon's plaster adhesive traction straps terminating in tapes which are caught over hooks at the distal end of the quadrangle. Traction may be regulated by thumb nuts on the screw thread of the hooks whereby the stretching of the ligaments at the metacarpophalangeal joints may be effected (Fig. 34).

The type of case which offers the most serious difficulties to the restoration of manual dexterity is that involving the tendons at the wrist binding them down and massing them, as an extensive scar, which in all instances can not be appreciated as to extent by what appears on the surface, because the primary infection involves not only the tendon sheaths but extends subcutaneously in all directions that are anatomically possible, so as to cause adhesive agglutination of the fascial spaces and bursæ as well; added to this the fusion of the carpal bones by impaction plus an inflammatory process renders the wrist-joint and tendons immobile and ankylosed, so that little can be done to aid such cases if extensive as shown by the X-ray and unyielding under an anæsthetic and later to physiotherapy.

Finally, arthrodesis, if extensive between the radius and ulna, preventing pronation and supination, hampering the proper use of the hand, is a difficult complication to combat because by the operative chiseling away of the union and the implantation of fat and fascia or muscle, one can rarely be sure of curative results, for in spite of all we do, the bridge of bone will more often than not re-form.

In conclusion, I wish to express my thanks to Doctor J. Fletcher Lutz for the X-rays and to Misses Salome Slingluff and Anita De Goll for their painstaking drawings for this article.

A STUDY OF CHRONIC ENDOCERVICITIS[1]

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SINCE 1862, when T. A. Emmett began his observations upon the cure of "cervical erosions," chronic endocervicitis has been the "bugbear" of all conscientious gynecologists. That there was a very annoying discharge issuing through the cervical os was a well-known fact, but the cause of this symptom no one seems to have known. Uteri were curetted; cervices were treated by all "manner of means" and still the leucorrhœa persisted.

Amputation of the cervix was known to be a curative procedure in a certain proportion of these cases, but the operation, often incompletely performed, left a cervical stump, which, in the child-bearing period of life, gave trouble and in many instances did not cause the discharge to disappear. Therefore, this procedure was not universally looked upon with favor when performed for so simple a complaint as leucorrhœa.

Coming to our present day conception of chronic endocervicitis, we now know, mainly through the work of Sturmdorf, of New York, and Curtis, of Chicago, that the primary cause of this annoying symptom, cervical leucorrhœa, is infection of the cervical mucosa, which, sooner or later, involves the deeper structures, producing a cervicitis, and we believe, furthermore, may even cause a parametritis, salpingitis, ovaritis, etc., and that the only successful way to stop the discharge is by the eradication of the infected focus.

In both structure and function the cervical mucosa differs widely from the endometrium of the corpus uteri. The cervical canal, lined with its mucosa, acts simply as a passive communicating channel between the vagina,

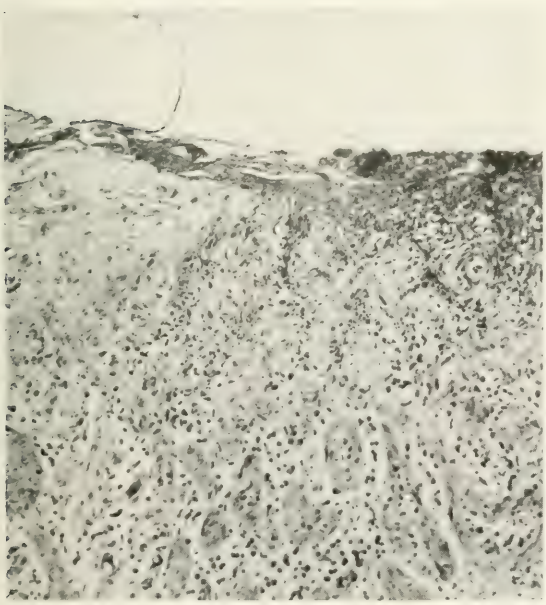

Fig. 1 Microphotograph of section (high power) through *a*, Fig. 5, showing granulation tissue, erosion, new formation of gland tissue, and marked chronic inflammation as shown by marked round-cell infiltration, engorged blood vessels, and lymph spaces with resultant fibrous tissue formation.

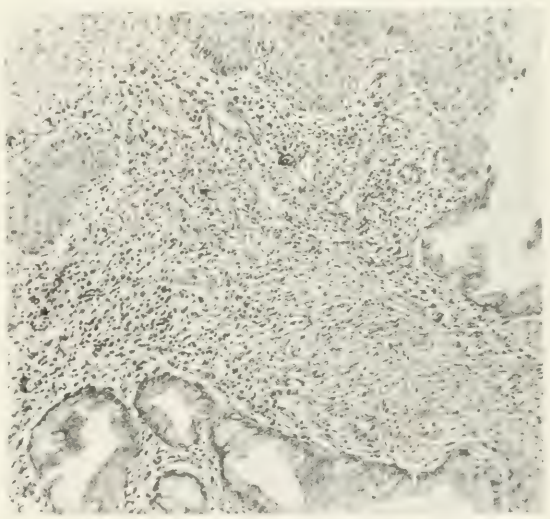

Fig. 2. Microphotograph of section (high power), 1 centimeter above section in Figure 1, showing glandular erosion, cystic formation from plugging duct of gland with marked round-cell infiltration, deposition of fibrous tissue, etc. (chronic inflammation.)

[1]From the Department of Obstetrics and Gynecology of the Long Island College Hospital. Read before the Brooklyn Gynecological Society.

Fig. 3. Microphotograph of section (high power) at *b*, Fig. 5 showing marked chronic inflammation with large dilated gland beginning Nabothian cyst in lower right field.

Fig. 4. Microphotograph of section (high power) at *c*, Fig. 5, just inside the internal os, showing very few chronic inflammatory changes.

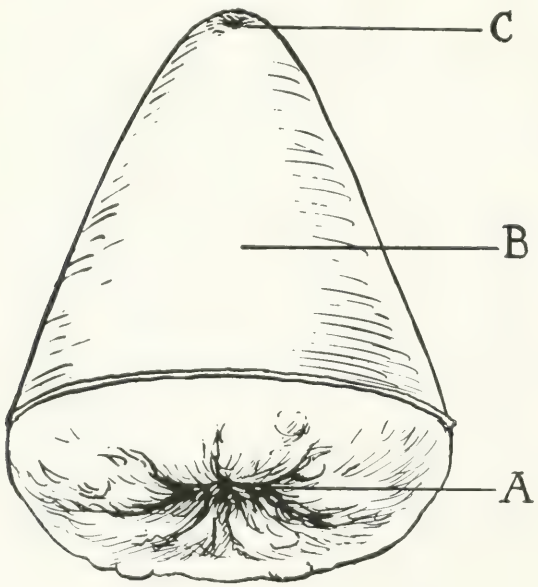

Fig. 5. *a*, External os; *b*, internal os. Sections at *a*, show marked chronic endocervicitis with cystic formation; at *b*, the same condition, but to a lesser degree, while at *c*, if the "cone incision" has gone beyond the focus of infection, there should be no signs of a chronic inflammation.

which is always the habitat of many and various bacteria, and the uterine cavity, while the corporeal endometrium is constantly passing through the active changes which are essential to menstruation and deciduation. The cervical mucosa, composed largely of deep penetrating racemose glands, evinces a marked susceptibility to infection, while, according to Curtis, the corporeal endometrium is practically immune.

Therefore, endocervicitis should be a very common disease, and endometritis, as a pathological entity, should rarely be met with.

Inflammation of the intracervical mucosa may be acute or chronic and may occur either as a primary or secondary infection; primary when the infecting agent directly invades the cervical mucosa and secondary when the infection extends upward from the vagina or downward through the uterus.

The organisms most commonly found are the gonococcus, staphylococcus, streptococcus and colon bacillus, the gonococcus and staphylococcus being by far the most prevalent.

Fig. 6. *a*, Excised cone of cervix; *b*, cone laid open. Cervical cone—comparable in size to normal-sized uterus, shows enormous size that cervix may attain through hypertrophy, caused by chronic low-grade inflammation extending over many years. At *a*, notice how completely that fibrous tissue has replaced muscle tissue; at *b*, notice that only a small portion of muscle tissue remains; at *c*, Nabothian cysts; at *d*, infected mucous membrane enormously thickened.

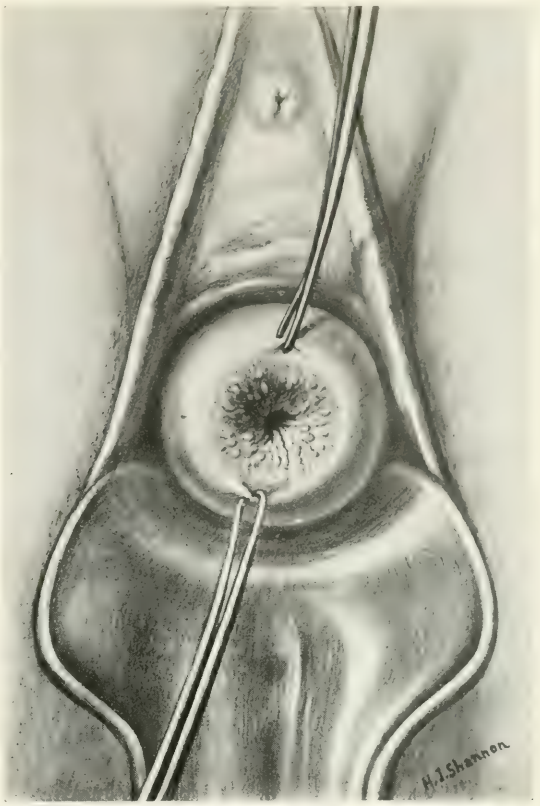

Fig. 7. Cervix exposed. Tenacula in place demonstrating area to be excised.

Trauma, *e.g.*, lacerations during childbirth, dilatation, curettage, cauterization, the constant irritation of a stem pessary, opens up avenues for infection and are thus predisposing factors in the production of chronic endocervicitis.

But, remember! trauma is only a contributory cause, for, as Sturmdorf so aptly states, "The dominating pathologic factor that determines the morbidity of a cervical laceration is not the extent of the tear, but the incidence of its infection. Such an infection does not remain limited to the lacerated area, but sooner or later involves the entire endocervical mucosa from the external to the internal os."

In children vulvovaginitis from any cause, the exanthemata, especially diphtheria and scarlet fever, and the general debilitating diseases often produce a marked susceptibility to cervical infections.

Acute endocervicitis and cervicitis occur in the course of acute gonorrhœal and puerperal infections of the uterus, but are seldom recognized at this time as definite pathological entities.

The mucosa of the cervix when chronically infected is swollen and often everted, while the mucosa of the portio about the external os presents a circumscribed area of glandular proliferation. The columnar epithelium covering the mucosa of the cervical canal, under the constant stimulation of infection, actually pushes itself out on to the vaginal aspect of the cervical rim, replacing the stratified epithelium which is normally present in this situation, thus producing the so-called *erosion*. This erosion, or "red area," about the external os, therefore, is not

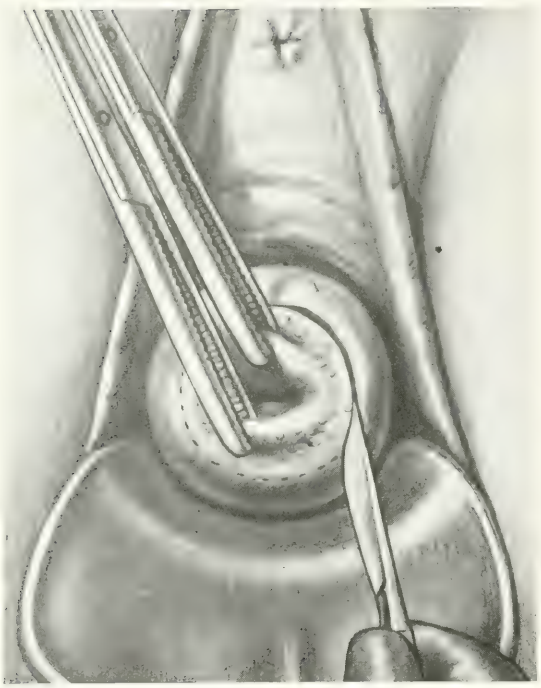

Fig. 8. Outlining with knife external limits of erosion to be excised.

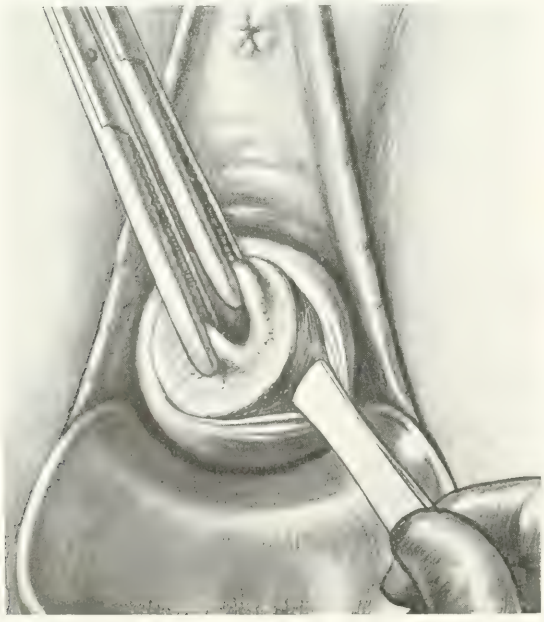

Fig. 9. Pushing back mucous membrane with handle of knife, following the natural line of cleavage. No bleeding.

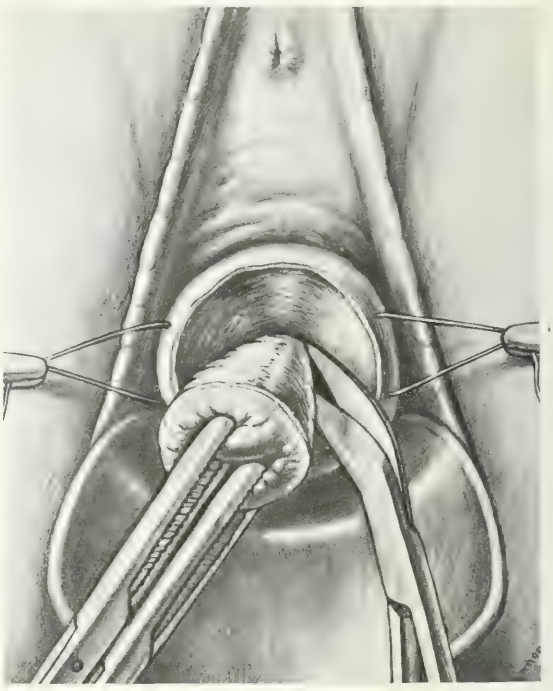

Fig. 10. Extending the "cone incision" using very sharp-pointed, curved-on-the-flat scissors. A long narrow scalpel may be used.

an ulceration in any sense of the word, but is a new formation of gland tissue and may, under certain conditions, become malignant. The continued congestion incident to such a condition produces a hypersecretion of mucus from the gland structures and ultimately a hyperplasia and hypertrophy of the cervical connective tissue. Sooner or later the crypts of these glands become occluded with consequent cyst formation—the so-called Nabothian cysts so familiar in this region of the cervix.

This cyst formation may take place partly by the hyperplasia of the periglandular connective tissue encroaching upon the lumen of the glands and partly by the overproduction of thick viscid mucus plugging the outlet ducts or during the process of cure or even attempted healing the squamous epithelium may grow out over the erosion and actually "choke" or cover over the gland openings.

This cystic condition, as might naturally be expected, increases the bulk of the already hypertrophied cervix and thereby interferes

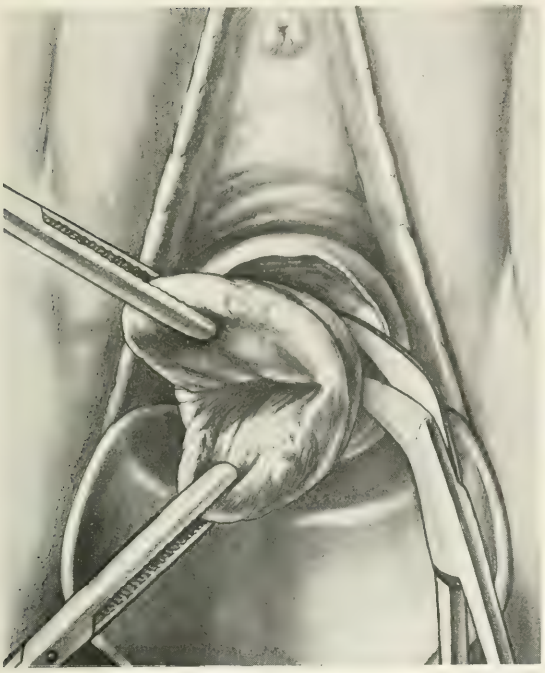

Fig. 11. Same as Figure 10, showing "cone incision." It may also be used for deeply lacerated cervices.

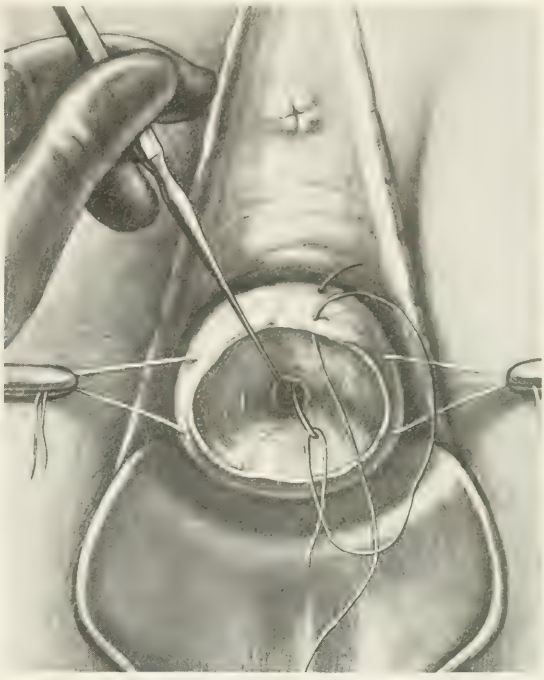

Fig. 12. Showing first half of the double inverting stitch as suggested by Sturmdorf.

with its circulation and muscular contraction. It is this hyperplasia which causes the pre- and the postmenstrual metrorrhagia so frequently met with in multiple cystic formation of the cervix.

Microscopically we may find all the evidences of a chronic inflammation, or in many instances there is very little inflammatory change in the stroma, and except for a preponderance of gland tissue, the section appears almost as normal cervical tissue. Section of a Nabothian follicle may show as a large clear space lined with columnar epithelium and filled with mucus. Surrounding this there may be the signs of an active chronic inflammation, as shown by round-cell infiltration, œdema, congestion, dilated lymph spaces, etc. In the musculature nearest the cervical mucosa, there may be found small inflammatory foci or even small multiple abscess formations.

Sections from the excised cones (Figs. 5 and 6) show erosions, chronic inflammation, cystic changes, etc., as described in varying degrees of intensity. Beginning at

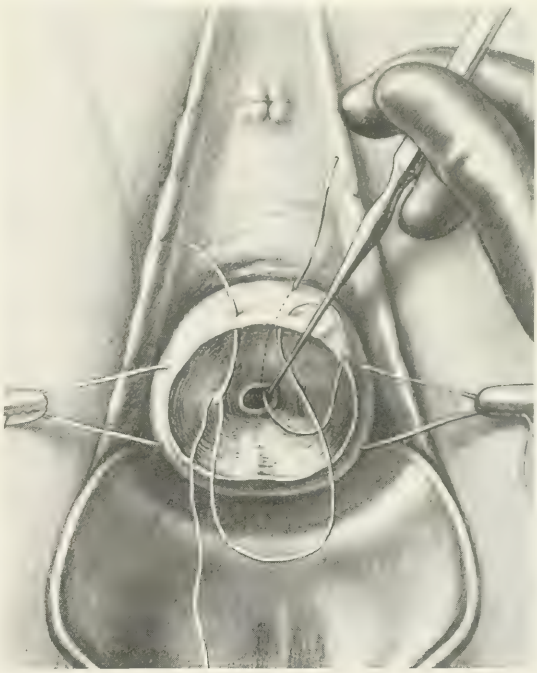

Fig. 13. Showing second half of the double inverting stitch as suggested by Sturmdorf.

the distal end we find marked inflammatory changes, but as we approach the proximal extremity, i.e., near the internal os, these changes are either barely perceptible or are entirely absent, showing the efficiency of the

Fig. 14. Longitudinal section of the cervix and uterus showing the inversion of the cervical reflection of the vaginal mucous membrane. *a*, Stitch placed; *b*, traction on sutures with partial inversion of mucous membrane; *c*, more traction on suture with complete inversion of mucous membrane.

procedure to be described in so far as the removal of the infected area is concerned (Figs. 1, 2, 3, and 4).

The clinical course of chronic endocervicitis is slow and insidious and shows little or no tendency toward a spontaneous cure.

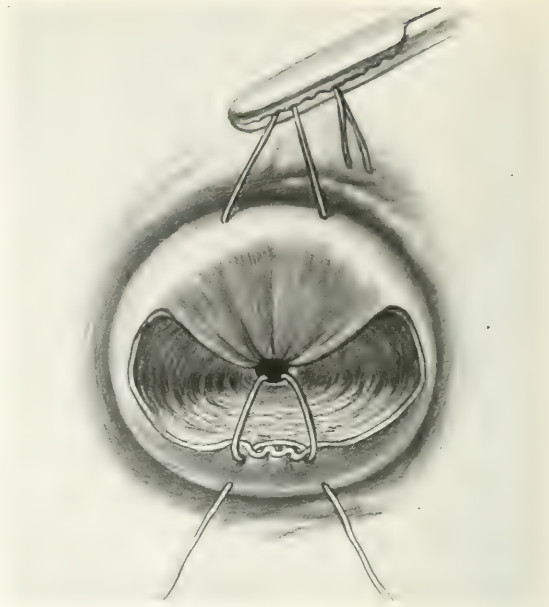

Fig. 15. Sutures placed. Inversion by traction completed for anterior flap. Note position of suture in posterior flap—not yet drawn up.

The symptoms are variable. In the milder cases, where the infection is not sufficiently virulent to be progressive, cervical leucorrhœa of a mucoid character, which may be scanty or profuse, is the only symptom complained of—very simple to describe, but often extremely invidious to the patient and well nigh invincible to the physician. When the infection extends to the deeper structures

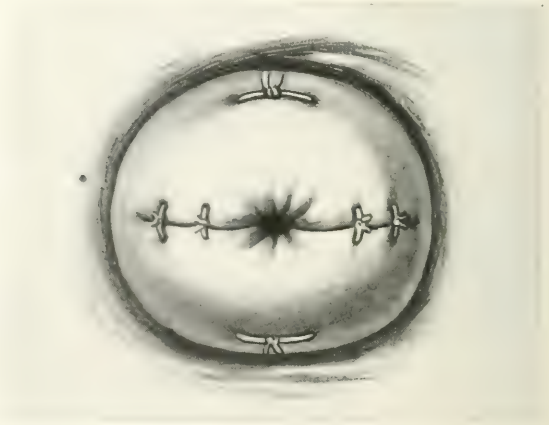

Fig. 16. Operation completed. Note only 6 sutures are required.

of the cervix and the uterus, giving rise to an ascending lymphangitis, which, we believe, may extend into the parametrium up through the lymphatics to the fallopian tube, producing a perisalpingitis or endosalpingitis, peritonitis, and ovaritis, the symptoms are those of a chronic pelvic inflammation accompanied by a profuse mucoid or mucopurulent cervical discharge. Under such circumstances the subinvolution which the circulatory and lymphatic stasis causes, renders these structures more susceptible to new infection and less resistant to the old infection.

Chronic endocervicitis is always attended by some degree of posterior cellulitis in the uterosacral ligaments, which explains the premenstrual and the comenstrual backache and dyspareunia so frequently complained of. The prominent symptom in most cases is leucorrhœa. This discharge is intermenstrual, is mucoid in character, usually profuse and viscid, translucent or opaque, or curdy, or it may be purulent when the inflammation is suppurative. It is always more abundant just before and after the menstrual period. The patient often suffers from metrorrhagia and menorrhagia, resulting from the circulatory stasis and the intermuscular lymphangitis which has impaired the contractile power of the uterine muscle. The lumbosacral pain is due to the traction of the cervix on the thickened, tender, uterosacral ligaments. Many patients complain of no symptoms, though examination will always reveal the erosion, the cystic hyperplasia, and the presence of a cervical discharge.

Sterility in women with apparently normal cervices, which may or may not be anteflexed, is, in the vast majority of cases, due to the existence of a chronic endocervicitis, dating either from childhood or from an infection soon after marriage. Such an infection need not be gonorrhœal, for we know that staphylococci from the husband's prostate gland are sufficiently virulent to infect the cervical mucosa of his wife, even though his last debauch was 20 years previous to his marriage.

Reynolds, of Boston, has demonstrated that a spermatozoon, no matter how vigorous, cannot long withstand the strain of progress through the thick, tenacious mucus that plugs the canal of a diseased cervix.

Furthermore, the cervical infection following lacerations of the cervix in those women who have borne one child, but have subsequently remained barren, must be recognized as a very important factor in the production of their continued sterility.

The prognosis in chronic endocervicitis is doubtful. When the infection is slight and the coincident inflammation mild and treatment is instituted early, complete recovery may take place. On the other hand, when the infection is virulent and the inflammatory changes are marked, many possibilities loom in the field. The cervical glands may harbor infecting organisms for years. These glands are situated in tissue that is more or less richly supplied with lymphatic drainage. These lymphatic channels pour their contents into lymph channels which communicate with the lymphatic chains in the parametrial tissues and in the uterosacral ligaments. Hence the associated lesions as metritis, parametritis, and uterosacral cellulitis, are progressive and not until the focal infection is cured can these associated lesions, which produce the symptoms of leucorrhœa, menorrhagia, metrorrhagia, and lumbosacral backache, be improved. Furthermore, long-continued cervical inflammation may be considered a prodrome of cervical cancer, for it is but a step from the extreme cell proliferation with an orderly arrangement that occurs in hyperplastic endocervicitis to the disorderly arrangement of embryonal cells found in cancer.

The treatment of chronic endocervicitis is palliative or operative—usually operative.

The palliative treatment, local and systemic, is well known. I wish to state, however that, after giving all of the local methods for the cure of chronic endocervicitis a fair trial, we have come to the conclusion that, aside from the treatment of simple erosions of limited area which have not become infected, palliative measures do not cure chronic endocervicitis. This will become evident when you recall the pathology of the condition, which is infection,—tissue reaction,

cell proliferation—increased gland activity, and hyperplasia. How can local palliative treatment alter such a pathological condition?

Furthermore, how can the curette effect a cure in such a condition. By curettage we do not remove all the gland tissue of the cervical mucosa, and wherever the gland tissue remains undisturbed, the infection remains unmolested. The infecting organisms inhabit the most remote branches of the deepest racemose glands in the cervical mucosa and, therefore, the futility of eradicating all infective foci by the use of the curette is at once apparent. It cannot possibly be done.

Sturmdorf, in his very excellent work, has called attention to the pathology resulting from chronic endocervicitis and has suggested excision of the infected area by a method which preserves a greater part of the cervical musculature (Figs. 5 and 6).

During the past 3 years, at the Long Island College Hospital, we have treated all cases of extensive chronic endocervicitis with the associated tissue hyperplasia by the surgical method of Sturmdorf. The technique of this procedure with certain modifications, which we believe are advantageous, is as follows:

With the patient anæsthetized and placed in the lithotomy position, and the vulva, vagina, and cervix prepared for operation, the anterior and posterior lips of the cervix within the margin of the erosion are grasped with Jacob's forceps and the cervix pulled down (Fig. 7). An incision is then made through the mucous membrane of the portio, encircling the limits of eroded area (Fig. 8).

The portical mucosa is pushed back for a distance of 3 or 4 centimeters or more, if necessary, to acquire sufficient flap of mucous membrane completely to cover over the excised area of cervical tissue (Fig. 9). Then, with a sharp-pointed pair of Emmett's scissors, while traction is being made on the cervix by the Jacob's forceps previously placed, the entire glandular area surrounding the cervical canal is "coned out," the "cone-incision" extending up to or just below the internal os (Fig. 10). Great care should be exercised in preserving all the muscle tissue possible and still remove all the infected area. If too much cervical tissue is removed, the operation becomes a high amputation, which, for obvious reasons, should be avoided (Fig. 11). If, on the other hand, not enough tissue is removed and infected glands are left behind, the purpose of the whole operation is defeated. Before removing the conical plug, which is now attached only by a small rim of cervical tissue and cervical mucosa, two sutures of No. 2 chromic catgut on a cervix needle are placed through the previously liberated flap of vaginal mucous membrane to either side of the partially-excised cone, including a good bite of cervical tissue. When these sutures are drawn taut, the operative field is brought well down toward the vulva. The cervical canal, at the uppermost limit of the cone, is now opened and a single tenaculum is introduced into the canal for the purpose of further bringing the cervical stump down nearer the vulva. When this is done, the remainder of the cone is excised.

The vaginal flap originally liberated at the beginning of the operation, is now inverted into the hollowed-out shell of the cervix by the double inverting stitch of Sturmdorf (Fig. 12). This manœuvre brings the vaginal mucosa into contact with the cervical mucosa and this completely covers all the denuded areas and, furthermore, substitutes healthy vaginal mucosa for infected cervical mucosa. This stitch is of silkworm gut and when tied, not only coapts the vaginal mucosa to the cervical mucosa, but controls bleeding from the tissues through which it passes (Fig. 13.) This suture is left *in situ* for 3 or 4 weeks, or until the patient returns for her follow-up examination after discharge from the hospital (Fig. 14). The chromic gut sutures to either side, which have thus far acted as traction sutures, are now tied (Fig. 15), bringing the gaping outer angles of the "coned incision" together and completely controlling hæmorrhage (Fig 16). With all sutures tied, six in number, the operation is complete and a small strip of iodoform gauze drain is placed against the cervical stump, which is removed in 24 hours.

I have collected from our records at the Long Island College Hospital 200 cases

in which from 6 months to 3 years have elapsed since operation, with the results as shown below. Cases of marked chronic endocervicitis with and without lacerations:

Cured	128, or 64 per cent
Improved	56, or 28 per cent
Unimproved	16, or 8 per cent

These results compare very favorably with Leonard's report of amputation of the cervix in 109 cases with marked leucorrhœa from Dr. Howard A. Kelly's clinic at the Johns Hopkins Hospital in which 62.5 per cent were cured, 30 per cent were improved, and 7.3 per cent were not improved. But it should be remembered that the operation above described is not an amputation of the cervix in any sense of the word and the various complications that may arise especially in the child-bearing woman from amputation of the cervix are very materially lessened or entirely avoided in the operation of excision of the cervical mucosa. We have not delivered a sufficient number of these women upon whom excision of the cervical mucosa has been performed, to draw any definite publishable conclusion, but so far, in a limited number of cases, we are of the opinion that a cervix upon which the "cone operation" has been done will cause but little, if any, more trouble during pregnancy and labor than one upon which trachelorrhaphy has been performed.

CONCLUSIONS

From this study the following conclusions may be drawn:

1. That chronic endocervicitis is a very common and intractable disease which has far greater possibilities in the production of pelvic disease than has heretofore been supposed.

2. That in the vast majority of cases the only hope of a cure is the complete removal of the infected focus.

3. That while the surgical method herein recommended is not a perfect one, we believe that, when properly done, it is, at the present time, the best method we possess for the eradication of the infected area.

I take this opportunity to acknowledge my indebtedness to Dr. John Osborn Polak for placing at my disposal the material which made it possible to carry on this work, and to Dr. Arnold Sturmdorf, of New York, for his many valuable suggestions.

EPICONDYLITIS HUMERI

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ON numerous occasions I have encountered a condition in individuals engaged in heavy manual work, characterized by pain in the elbow region and functional impairment to a greater or lesser degree, together with persistent tenderness limited to the epicondyle of the humerus, and I have sought some confirmation of this clinical picture in the literature extant. While this condition has not been dignified as an entity in the current textbooks of surgery in the English language, I do, however, find some very pertinent references to it in a discussion which was participated in by several German authors in 1910.

The following case will illustrate the condition quite clearly:

M. S., age, 60; peddler; Russian; married; remembered no previous illness except influenza 3 years ago. When first seen in my surgical service at the Good Samaritan Dispensary, he complained of pain and tenderness in the right elbow region, weakness of the forearm, and difficulty in lifting with his right hand. These symptoms came on suddenly 6 weeks previously, and he attributed his condition to his occupation; he believed that in the act of throwing into the air toy balloons he had strained his arm.

There was nothing in the general physical condition that had any bearing on the local findings. His right elbow presented no external signs of inflammation. Pressure over the external epicondyle

elicited exquisite tenderness. Flexion and extension of the elbow caused pain. The hand grip was weaker than on the opposite side, and lifting with the right hand in supination was possible with difficulty but almost impossible with the hand in pronation. There was no atrophy of the muscles of the forearm or arm. The urine and blood Wassermann were negative. X-ray examination showed a prominent external epicondyle, but the picture of the opposite side revealed the same condition. There was no endosteal nor periosteal change. The progress of the case therapeutically over a period of 2 months was not successful. Immobilization in semiflexion, massage, and the internal administration of salicylates produced but little improvement.

Two other cases, one in a presser of clothing and the other in a piano polisher, the latter from the surgical dispensary of the Presbyterian Hospital, were analogues of the above case. In the latter case the symptoms were present for one year with periods of intermission and remission.

In a series of cases reported by Vulliet, Franke, Bernhardt, Momburg, and Dubs, the average duration of the condition is about 6 weeks. The symptoms disappeared either gradually or sometimes over night, with only a persistence of the tenderness over the epicondyle. During the course of the disease, there may be free intervals of several days with recurrence. The etiology is a doubtful point. Momburg laid stress on the disease being postinfluenzal and thinks that trauma and strain are open for discussion. Bernhardt is inclined to call it an occupational neuralgia and thinks that strain is a distinct etiology. Franke believes in strain, and in one case he exsected the epicondyle. Dubs, in an experience with 9 cases, comes to the conclusion that tennis elbow and Vulliet-Franke epicondylitis are identical. He believes that the trouble lies in the capsule of the elbow-joint rather than the epicondyle, because of negative X-ray findings.

With extended experience, I would not have the impression prevail that this train of symptoms need be limited to the epicondyle. Of late, I believe I have seen similar involvement of the styloid process of the radius and the condyle of the femur, all in individuals who subjected these parts to severe muscular effort. Franke, in his original article, also emphasized affection of these anatomical processes. In all my cases, however, the tenderness was not so marked as in the epicondylitis humeri, and there were slight diffuse swelling and redness, never encountered in epicondylitis humeri.

CONCLUSION

The nomenclature, epicondylitis humeri, has been adopted for the title from Franke's original article. It is a definite syndrome, the etiology of which is in dispute, and, I think, once seen can usually be diagnosticated. Immobilization seems to be the best treatment. Its course seems to be self-limited and may be rather protracted, notwithstanding additional therapy.

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ABSCESS OF THE PROSTATE[1]

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THIS paper is based upon a series of 43 cases that were seen in hospital, consultation, and private practice.

Abscess of the prostate is generally looked upon as a complication of gonorrhœa. Most textbooks on genito-urinary surgery consider it as a complication, and in a discussion of this subject one finds it described under the heading of complications of gonorrhœa.

There are cases of abscess of the prostate, however, which are not complications of gonorrhœa. It is a well-known fact that abscess of the prostate may occur as a complication of some of the acute infectious diseases, such as typhoid fever, mumps, and influenza. This fact has again been called to our attention by Bugbee, who in a recent paper was able to report 5 cases of abscess of the prostate that were seen as complications of cases of influenza that occurred in the recent epidemic. Guiteras' case of abscess of the prostate, occurring in an attack of measles, is another example of this type of case met with in the course of one of the acute infectious diseases.

There is still another group of cases in which the abscess is metastatic in origin and in which a primary focus of suppuration can be demonstrated. It would appear, upon careful study, that this type of case occurs more frequently than is generally the opinion.

In this series of cases we had a number of instances in which an abscess of the prostate followed a focus of infection remote from the prostate. These cases seemed to be of sufficient interest to merit a detailed report and will be considered later in the paper.

For purposes of study the 43 cases have been divided into the following groups:

1. Cases complicating gonorrhœal urethritis;
2. Metastatic abscess of the prostate;
3. Abscess of prostate following trauma to urethra, *e.g.*, instrumentation;
4. Abscess of prostate associated with hypertrophy;
5. Abscess of prostate associated with strictures of urethra;
6. Abscess of prostate associated with appendicitis;
7. Abscess of prostate associated with stone;
8. Abscess of prostate in which the etiology was not determined;
9. Abscess of prostate and general sepsis.

Of these 43 cases, there was one in which the age was not stated. The decades in which abscess of the prostate occurred were:

Years	Cases	Percentage
Not stated	1	2.32
11 to 20	1	2.32
21 to 30	11	25.58
31 to 40	15	34.80
41 to 50	11	25.58
51 to 60	1	2.32
61 to 70	3	6.96

Previous operations. One patient had been operated upon—an external urethrotomy and an epididymotomy—many years before the abscess of the prostate developed. Another patient had had his right testicle removed because of traumatism, the abscess, which was gonorrhœal in origin, developing 4 months after the testicle operation. One patient was operated upon for rectal abscess in 1919 and also for fistula in ano, the abscess developing after the passage of sounds. Another patient had been operated upon for suppurative appendicitis and had left the hospital 12 days before he was readmitted because of complete retention of urine. In view of the fact that he had never had gonorrhœa and there was no evidence of past or present gonococcus infection at the time, it is reasonable to assume that there was some causal relation between the suppurative process in the appendix and the prostatic abscess. These cases will be considered in detail later in the paper.

Previous illnesses. Of this series of 43 cases of abscess of the prostate, 30 cases gave a

[1]Read at the annual meeting of the American Association of Genito-Urinary Surgeons, Rochester, Minnesota, May 31, June 1 and 2, 1920.

positive history of gonorrhœal infection, either recent or remote. Thirty of these cases showed at the time of admission to the hospital the presence of an acute or chronic urethral discharge, or gave a history of a recent gonorrhœal infection. Examination of the discharge showed the presence of the gonococcus in 16 cases.

Routine blood Wassermann reactions and gonococcal complement fixation tests were not made in all the cases, this not being possible for various reasons. The Wassermann reaction was reported negative in 16 cases and positive in 3 cases. Gonoccocal complement fixation tests were made in 22 cases, and were found negative in 11 cases, positive in 11.

In the 11 cases in which the gonococcal complement fixation test was positive, gonococci were found in the urethral discharge or in the pus obtained from the abscess. In the 11 negative reactions, 7 patients showed the presence of an urethral discharge and 3 had gonococci in the discharge. Two of the remaining 5 cases were metastatic cases: one, secondary to a carbuncle; the other, to an osteomyelitis of the finger. One patient had been treated with sounds. In 1 case there was no venereal disease present. The remaining 2 cases gave a history of a chronic discharge.

Examination of pus from the abscess. In 18 cases gonococci were found in the pus obtained from the abscess. Staphylococci were recorded in 5 cases; streptococci in 1 case; both staphylococci and streptococci in 2 cases; and bacillus coli in 1 case. In one case the cultures remained sterile, and microscopic examination of the pus failed to show the presence of organisms. The 4 cases showing staphylococci in the prostatic pus, yielded the following data:

One patient had no evidence of gonorrhœa at the time he entered the hospital. One patient had all the symptoms and signs of active gonorrhœa, including a positive gonococcal complement fixation test. The third patient had no signs of gonorrhœa and the fourth occurred in a patient, aged 67, who had been catheterized because of retention due to hypertrophy. The 2 cases showing a combination of staphylococcus and streptococcus, were nonvenereal cases.

Leucocyte counts. There were 23 cases in which blood counts were made and all showed the presence of a leucocytosis. The highest leucocyte count recorded was 30,000. With the opening of the abscess surgically, or its rupture into the urethra, a prompt drop in the leucocyte count occurred. The differential leucocyte count showed the presence of an increase of the polymorphonuclears. A differential leucocyte count was not made in all the cases. In 1 case, in which this was done, the presence of an eosinophilia was found.

METASTATIC CASES

Metastatic abscess of the prostate is a rather uncommon clinical picture, and the prostatic condition is often not recognized until late in the course of the patient's illness, being overshadowed by the primary focus until the onset of complete retention of urine or painful and difficult defæcation, at which time a rectal examination is made. Von Frisch has reported 2 cases of this type: one associated with a severe phlegmon of the forearm and the other secondary to a phlegmonous angina. Legrain has reported a case in which the primary focus was a phlegmon of the forearm in which the thumb was amputated because of necrosis of the bone of the thumb. In 1 of my cases there was a necrosis of the last phalanx of the index finger.

In 1 case in this group, the patient gave a very definite history of acute tonsillitis with chills and fever. A few days after the onset of the acute tonsillitis, the patient was seized with symptoms which were attributed to an attack of acute cystitis. Urination became more difficult and painful, and complete retention set in, necessitating the use of an indwelling catheter. A perineal operation was done elsewhere and pus evacuated. Unfortunately, complete data are not available.

A case recently reported by Randall was metastatic in origin, the primary focus being a series of boils. As examples of this type of prostatic abscess, permit me briefly to present the following cases:

Case 1. R. U., age 48, referred by Dr. Cramps. The patient denied venereal infection.

Four weeks before admission to hospital, patient developed a felon on the index finger of his right

hand. This was opened by his physician and treated with wet dressings. A fortnight later he developed repeated attacks of chills and fever, at which time he was obliged to urinate from 10 to 12 times during the day and from 5 to 6 times at night. He also complained of pain in the region of the rectum which radiated toward the base of the bladder and was associated with the act of urination. Difficult urination began a week later and gradually increased in severity so that he developed complete retention.

Examination. A suppurative wound was found on the index finger of the right hand. External genitalia, negative; no discharge. Urinalysis: Specific gravity, 1,020; trace of albumin, sugar and casts, negative, few pus cells and a few red blood cells. Examination of the blood showed a leucocytosis of 28,000. Wassermann reaction and gonococcal complement fixation test were negative.

Rectal examination showed an enormous, soft, fluctuating swelling in the region of the prostate. The swelling extended beyond the reach of the finger; hence, the seminal vesicles could not be felt. The prostate was very painful upon examination.

A perineal operation was performed and the abscess drained. An abscess was found in each lobe.

Examination of the pus from his finger showed the presence of streptococci, and the pus obtained from the prostatic abscess, streptococci, staphylococci, and bacilli.

Blood cultures were made on two different occasions and each set of cultures remained *sterile.*

Case 2. D. Y., age 43, referred by Dr. Daniel E. Murphy. Venereal infection denied.

The patient had been under treatment by his family physician for a carbuncle in the back of his neck, which had been incised and drained. Two weeks before admission to hospital, patient began to have frequency of urination to so great an extent that he was obliged to void every few minutes during the day and 4 or 5 times at night. He complained of pain associated with the act of urination, which was located chiefly in the glans penis. Increased difficulty of urination gradually developed; this caused him to strain a great deal which was accompanied with very severe pain in the rectum. The day before admission, he developed complete retention of urine which necessitated catheterization that night.

Examination. A partly healed wound was found in the back of his neck. Above the symphysis pubis was felt a large mass which was interpreted as being due to a distended bladder. External genitalia, negative; no discharge. Urinalysis: specific gravity 1,018 acid; albumin+, and some pus cells. Cultures showed bacillus coli.

Rectal examination revealed a large, smooth, fluctuating mass in the left half of the pelvis. This mass was as large as a peach. The seminal vesicles were not felt.

Blood examination showed a leucocytosis of 15,600. Wassermann reaction and gonococcal complement fixation test were negative.

A perineal operation was performed and the abscess drained.

Staphylococcus aureus was found in the cultures made from the pus obtained from the abscess, and in the pus obtained from the wound in his neck.

A blood culture was made, but this remained sterile.

Blood cultures were made in both these cases. In the first case blood cultures were made on different days and both sets were negative. In the second case, only one blood culture was made and this remained sterile. Both cases entered hospital long after the beginning of the abscess.

ABSCESS OF THE PROSTATE FOLLOWING INSTRUMENTATION

Prostatitis and epididymitis may be noted very often after the rough and careless passage of sounds, metal catheters, cystoscopes, etc. These complications may occur in venereal as well as in nonvenereal cases. Abscess of the prostate following urethral instrumentation is not seen so frequently as the previously mentioned complications. It may be possible that some of the cases developing severe local symptoms after urethral instrumentation are in reality cases of abscess which are many times overlooked, or that they progress up to a certain point, undergo resolution, and for this reason are not recognized.

In several of the gonorrhœal cases the patients' symptoms developed soon after the passage of metal instruments by the local physicians, who disregarded the fact that a profuse gonorrhœal discharge was present at the time. There can hardly be any doubt between cause and effect in cases in which the acute onset of symptoms followed immediately after instrumentation. Five of Randall's 8 cases gave a history of previous urethral manipulation; such as, deep injections, passage of sounds, irrigations with potassium permanganate and catheterization.

In the series of 43 cases reported in this paper, a history of urethral instrumentation preceded the onset of symptoms of prostatic abscess in 17 cases. Of this number, 5 were gonorrhœal and 12 nongonorrhœal.

Case 3. A. L., age 44. Acute gonorrhœa 2 years ago. Patient has been under treatment off and on for this infection ever since onset. For several weeks prior to admission to hospital, he was under treatment by his family physician, who treated him with irrigations and the passage of large sounds. Three

days before admission and after the passage of sounds, he developed an acute attack of retention. This was associated with pain in the region of the rectum and in the perineal region. Before the onset of the retention, he was obliged to urinate four or five times at night, and the force of the stream was diminished. A slight amount of dribbling occurred after urination, which was associated with burning. After onset of the retention, patient had several attacks of chills and fever.

Examination. A slight discharge at the external urethral orifice. External genitalia, negative; Wassermann reaction, negative; gonococcal complement fixation test, negative. Blood examination showed 11,800 leucocytes. Urinalysis: Specific gravity 1,022; reaction, acid; albumin, blood, and pus, positive.

Rectal examination showed an enormous enlargement of the prostate which nearly filled the pelvis, with swelling more marked on the left side. Fluctuation could be elicited.

A perineal operation was performed and the abcess drained.

Examination of the pus showed Gram-negative diplococci = gonococci.

Case 4. E. S., age 47, referred by Dr. Daniel E. Murphy. The patient had had an acute gonorrhœal infection about 15 years before, from which he apparently recovered. In April, 1919, he was operated upon for a rectal abscess and in December, 1919, was operated upon for a fistula in ano.

Four weeks before admission to hospital, a No. 26 sound was passed and this was followed by a small amount of peri-urethritis. Later, several sounds were passed. After the passage of the last sound, patient developed frequency of urination, being obliged to void every half hour during the day and twenty times at night. Two days before admission to hospital, he developed pain located in the rectum and along the urethra. This pain was associated with the act of urination. He complained also of some difficulty in starting the stream. Two days prior to admission to the hospital, patient developed complete retention which necessitated his being catheterized three times. Also had chills and fever for a week before admission. A great desire to urinate, but was unable to void.

Examination. Scar from the operation for fistula in ano. A bean-sized lump was seen in the middle of the anterior urethra. Blood examination showed 15,600 leucocytes. Wassermann reaction, negative; gonococcal complement fixation test, positive 4+. Rectal examination showed the prostate enlarged and the right lobe about three or four times the normal size; the surface smooth.

Abscess ruptured into the urethra 2 days after the onset of retention. Following the rupture, patient had relief of symptoms and a return of normal urination.

Streptococci were found in the pus expressed from the prostate. No gonococci were found. Blood culture, negative.

ABSCESS OF THE PROSTATE ASSOCIATED WITH BENIGN HYPERTROPHY

When an abscess of the prostate without hypertrophy occurs in elderly men a diagnosis of benign hypertrophy is made, as a rule, and the abscess is not recognized. When the abscess with hypertrophy occurs in elderly men the abscess is often overlooked and a diagnosis of hypertrophy is made. At times, the differentiation may be very difficult, and cases have been reported in which the abscess was not recognized until the bladder was opened to remove a suspected enlargement of the gland.

In one case, a diagnosis of hypertrophy was made by the family physician and the presence of the abscess was not recognized. There was no enlargement of the lateral lobes *per rectum*. Cystoscopic examination showed a small median bar and rectal examination showed an abscess in one lobe. In the second case, a diagnosis of hypertrophy was made and found to be present, although the presence of the abscess had not been recognized before the patient was admitted to the hospital. In the third case, beginning enlargement of both lateral lobes and a small bar were demonstrated cystoscopically after operation for abscess.

One of the cases had complete retention of urine, necessitating catheterization every 6 hours. The retention was present for a fortnight prior to his admission to the hospital.

Case 5. J. F., age 67. Venereal infection denied. Patient was admitted to hospital because of complete retention. Had been having more or less bladder distress for about a year, which necessitated voiding from one to three times at night. Frequency was very materially increased 4 days prior to admission to hospital. Two weeks before admission, he had a chill and was unable to void; he sent for a doctor and was catheterized. Since that time, with exception of 2 days, catheterization every 6 hours.

Examination. External genitalia, negative, except for a large hydrocele on the right side. No urethral discharge. Examination of blood showed a leucocytosis of 14,400. Blood pressure: systolic, 136; diastolic, 80. Urinalysis: specific gravity, 1,020; cloudy; acid; trace of albumin, a few leucocytes, bacteria, and amorphous urates.

Rectal examination showed an enlarged prostate, the apex of which could easily be reached. Infiltration was present on the right side, extending to, and apparently filling, the bony pelvis. Prostate was soft in consistence and fluctuation was elicited.

During rectal examination, the abscess ruptured into the urethra. A large amount of bloody pus was obtained.

Examination of the pus showed a pure culture of staphylococcus albus.

Case 6. G., age 60, referred by Dr. George Parker. Venereal infection denied.

Patient complained of burning on urination and more or less pain in the urethra. A gradual increase in frequency of urination developed, compelling patinet to void every 2 hours, both day and night. Symptoms gradually increased in severity. About a week later, patient noticed great difficulty in urinating, being obliged to strain a great deal in order to start the stream. The difficulty became rapidly worse until finally there was inability to void and catheterization was necessary.

Examination. External genitalia, negative; no urethral discharge. Rectal examination showed a large, fluctuating mass in the right lobe of the prostate. The abscess was about the size of a plum and bulged into the rectum. Fluctuation could be elicited.

Cystoscopic examination showed a well-defined median bar and a beginning hypertrophy of the lateral lobes.

The abscess was opened through the rectum and patient made an uneventful recovery.

Case 7. J. McG., age 48. Venereal infection denied.

Patient stated that he had had more or less urinary frequency for 10 years, but the frequency was not constant. Complained of intermittent pains in the pelvis and above and behind the symphysis pubis. Some difficulty of urination; at times the stream was split. Two days before entering hospital, patient suddenly developed complete retention of urine which necessitated catheterization.

Examination. External urethral orifice, negative; no discharge. External genitalia, negative. Roentgen-ray examination, negative. Blood examination showed a leucocytosis of 10,000. Wassermann reaction and gonococcal complement fixation tests were negative.

Rectal examination showed the left lobe of prostate enlarged; surface smooth, fluctuation elicited.

A perineal operation was performed and the abscess drained.

Cystoscopic examination revealed a notch above, with slightly intravesical protrusion of the lateral lobes and a definite bar at the base.

ABSCESS OF THE PROSTATE ASSOCIATED WITH URETHRAL STRICTURES

One of the patients had suffered from urethral strictures for many years. These had been treated very irregularly with sounds. The passage of sounds gave him a great deal of symptomatic relief which, however, was only of short duration, necessitating the use of sounds every few months. The last sound was passed 7 weeks before the onset of symptoms of abscess of the prostate. Undoubtedly, the chronic urethritis and the frequent instrumentation were predisposing factors in producing the abscess.

Lasio has recently reported a case of abscess of the prostate due to stricture.

Case 8. F. C., age 39, referred by Dr. Charles Schott. Patient had urethritis, in 1898, of 4 months' duration; treated with irrigations. In 1916, patient had a very severe attack of bilateral bacillus coli pyelitis. Examination at that time showed the presence of the pus cells in the strippings obtained from his prostate. Seven weeks prior to onset of present trouble, patient had a great deal of difficulty in urination, for which sounds up to and including No. 25 French were passed.

One week prior to onset of abscess, patient was confined to bed, because of an attack of left-sided epididymitis. Frequency of urination present since onset of acute epididymitis, and this was associated with difficulty in urination; hence, urination was very slow and required a long time to empty the bladder. Associated with urination, there was a great deal of suprapubic pain radiating over the lower abdomen. Patient had chills, fever and sweats, and ran a temperature oscillating between 101° and 104° F.

Examination. External genitalia, negative. Right epididymis, negative; left epididymis, very sensitive and enlarged. Rectal examination showed the prostate enlarged to about three times its normal size. In the center of the prostate was a soft area, and in this area it was possible to elicit fluctuation. The rest of the prostate was hard. Both seminal vesicles were palpable.

A diagnosis of abscess of the prostate was made and patient advised to have the abscess opened through the perineum.

During the night the abscess ruptured into the urethra. Following the rupture, a large amount of pus was discharged from the urethra. Temperature rapidly returned to normal and the patient was relieved of his symptoms.

ABSCESS OF THE PROSTATE FOLLOWING APPENDICITIS

Whether or not there is any causal relation between abscess of the prostate and appendicitis, I am not prepared to state. Abscess of the prostate, as a remote complication of appendicitis, is not mentioned in textbooks on general surgery or on genito-urinary surgery; hence, when it occurs as a complication it may be only an incident. Nevertheless, in view of the fact that the patient, whose case

report follows, had an appendical abscess which was opened and drained, necessitating his being in the hospital for 19 days, and also in view of the fact that urethral instrumentation was not used, and no evidence of acute or chronic gonorrhœa obtained, one would be justified, apparently, in assuming that there may have been a causal relation between these two conditions.

Case 9. C. G., age 23, referred by Dr. Dean D. Lewis. Venereal infection denied.

Patient was operated upon for acute suppurative appendicitis by Dr. Lewis and the appendix removed. Patient remained in hospital 19 days and left in good condition. Twelve days after leaving, he returned, complaining of inability to pass his urine, at which time he was catheterized and the catheter passed quite readily. Went home and returned the next day, because of inability to urinate. At this time a No. 21 French sound was passed and no obstruction found.

Examination. Negative, except for a recent scar in the appendix region. External genitalia, negative. Blood examination showed a leucocytosis of 11,700 and hæmoglobin of 90 per cent. Blood pressure: systolic, 150; diastolic, 108. Urinalysis: specific gravity 1,020, turbid, amber; albumin, red blood cells and bacteria, positive.

The cystoscope was introduced into the bladder with a little difficulty owing to an apparent obstruction in the deep urethra. This resulted in the rupture of an abscess with an outflow of a large amount of thick, yellow pus. This was followed by an immediate relief of his symptoms.

Rectal examination showed the prostate large and very hard. (The examination was made at once.) By applying pressure on the prostate a large amount of pus was seen exuding from the external urethral orifice.

ABSCESS OF THE PROSTATE WITH CALCULI

This combination is a very rare one. Cases have been reported in which the abscess ruptured and a fistula remained. Calculi have been removed through the fistulous opening. Cases of this kind have been reported by Dupuytren, Joshua, Crosse, Baker, and Devin. Lydston recently reported 2 cases of stone and abscess of the prostate. In one case he removed a calculus from the abscess cavity; in the second, a perineal abscess was opened by the patient's physician and a stone weighing 700 grains removed.

One case in this series belonged to this group and calculi were diagnosed at the time of the patient's first admission to the hospital. This case was reported[1] in detail when the patient first came under observation. The abscess was a part of his terminal illness.

Case 10. F. A. K., age 57. At eighteen, patient had a lesion which was diagnosed as a chancre. Last attack of urethritis, 20 years ago. Patient had occasional attacks of pain in the hypogastrium. Attack of cystitis 2 years prior to onset of trouble.

Patient complained of frequent inability to urinate, frequency of urination, pain after urination and incontinence. Incontinence began 4 weeks before admission to hospital. Difficulty in starting stream was variable. Sometimes patient could not start the stream at all, and at other times he could only start the stream after sitting down and waiting.

The stream was slow, lacked force, and dribbled.

Examination. Pupils, irregular. Finger-to-finger test showed a slight inco-ordination. Pain sensation diminished in arms, chest, abdomen, and legs. Dr. Bassoe saw patient in consultation, and a diagnosis was made of scattered areas of degeneration both in motor and sensory areas, probably dependent upon arterial changes. Blood examination showed 10,200 leucocytes. Blood pressure: systolic, 165; diastolic, 65. Urinalysis: Specific gravity, 1,005; albumin, sugar, and blood, negative; a few granular casts. Wassermann reaction, negative; spinal Wassermann, positive. Cultures of the urine were sterile. Roentgen-ray examination showed the presence of multiple calculi in the prostate. Patient remained in hospital for several weeks and was discharged February 20, 1917.

Patient re-entered hospital, October 31, 1917, and was admitted to the medical service of Dr. James B. Herrick. Complained of shortness of breath, swollen feet, incontinence of urine, and headaches. On the medical service 21 days, and died November 20, 1917.

The autopsy was performed by B. O. Raulston, pathologist, Presbyterian Hospital. The following postmortem report is taken from his protocol:

Primary abscess of the prostate gland. This abscess contains thick creamy pus. Pus distended seminal vesicles. Thick pus exudes from the seminal vesicles. The lining of the urinary bladder is markedly hypertrophied; hyperæmic, but more hyperæmic in the prostatic region. Marked dilatation of the ureters and pelves of the kidneys containing pus. Hyperplasia of the peri-aortic lymph glands. Slight œdema of the lungs. Marked senile sclerosis of the aorta. Chronic myocarditis. Beginning aortic aneurism. Bed-sore of the lumbar region.

CASES IN WHICH THE ETIOLOGY WAS NOT DETERMINED

In some cases no apparent cause for the abscess could be found. The usual clinical and laboratory methods of examination failed

[1] Kretschmer, Herman L., Surg., Gynec. & Obst., 1918, xxviii, 70.

to demonstrate any possible etiological factors. It is in this group of cases that not only the adjacent viscera (urethra, rectum, etc.) should be carefully examined, but the possibility of distant foci of infection should be borne in mind. Various lesions of the rectum, such as fissures, fistulæ, abscess, ulcers, hæmorrhoids, etc., have all been mentioned as factors in the production of prostatic abscesses.

Recently, attention has again been called to the rôle of rectal lesions in prostatic abscess, by Brooks, Wilson and McGrath, Motz, and Vogel.

The possible rôle of distant foci, as an etiological factor, has undoubtedly not received as much consideration as it should. In this group of cases, careful examination should be made of the teeth, tonsils, and sinuses, as a routine. The case mentioned in the first part of this paper, in which the prostatic abscess developed after an acute attack of tonsillitis, seems to be of more than passing significance.

As an example of this group, the following will serve as an illustration:

Case 11. Wm. K., age 48. Venereal disease denied. In 1913 patient had an attack of appendicitis. In 1914 he had an attack of right-sided renal colic at which time many blood cells and casts, it is stated, were found in the urine. The present illness was sudden in onset and began with indefinite abdominal pain, general at first; later this was localized in lower abdomen. The entire abdomen was sore. This was followed by severe burning in and along the urethra. Patient said that he felt as though he had obstruction to urination and that it was necessary to urinate every half-hour to one hour at night, only a small amount of urine being passed each time. There was some interruption of the stream; and although the amount of urine voided each time was very small, the stream was often interrupted before the act was completed. When seen by his family physician, patient had not voided for 6 hours. Had had severe pain in the rectum and defæcation was very painful. A diagnosis of retention was made by his physician; a catheter was passed, but the bladder was found to be empty.

Examination. External genitalia, negative; no evidence of acute or chronic urethral discharge. Rectal examination showed an enlargement in the left lobe of the prostate, which was very painful to touch. Fluctuation could be elicited.

Roentgen-ray examination, negative. Wassermann reaction, negative. Examination of blood on October 3, 1919, showed 11,800 leucocytes; October 5, 30,000 leucocytes; October 15, 9,000 leucocytes.

The abscess ruptured into the urethra.

Examination of the pus showed the presence of staphylococci and streptococci.

For purposes of discussion, the cases falling into this category may be divided into the following three groups:

Group 1. An important point to remember in connection with abscess of the prostate is that the clinical picture may be that of general sepsis, masking or overshadowing the prostatic symptoms to so great an extent that the true nature of the patient's illness is not discovered until late in the course of the disease, and a diagnosis of general sepsis is made. At times a diagnosis of typhoid, chronic malaria, etc., is made. A case of this type was reported by Brooks in which a diagnosis of paratyphoid was made but not proved. The onset of painful defæcation in about the third week of the patient's illness lead to a rectal examination which revealed the presence of an abscess of the prostate.

Group 2. Under this heading may be considered cases of abscess of the prostate in which the abscess is part of a general sepsis and in which evidence of general sepsis is present. The case to be reported below seems to belong to this group.

Group 3. General septic infection may have its origin from suppuration of the prostate. A case belonging to this group has been reported by Roessle.

The patient had been kicked by a horse; the spleen was ruptured. There was an exudate in the splenic area, and after aspiration, fever and retention of urine set in. A perinephritic abscess was drained. Death occurred seven weeks later, from general sepsis. The autopsy revealed suppuration of a subphrenic hæmatoma; healed rupture of the spleen; embolic abscesses of both kidneys. The oldest pus focus was found in a complete suppuration of the prostate.

Case 12. M. H., age 45, admitted to hospital in a semicomatose state. Venereal disease denied. Four years ago, patient had an attack of retention of urine. Frequency of urination began 8 months ago and has been present ever since, patient being obliged to urinate every 3 hours, both day and night. In all, he has had eight or nine attacks of retention. Some of these were relieved by the use of hot baths and hot applications. Last attack, 4 days ago, relieved by hot baths. Last catheterization, 5 months ago. Was catheterized only once with a soft rubber catheter and that went in with difficulty. Urgency of urination is very marked and the patient

has no power to withhold the impulse of urination when it occurs; hence, the wearing of a rubber urinal is necessary.

Examination. Patient is very sluggish mentally: answers questions very slowly. Exploration of the urethra reveals the presence of many strictures in the anterior urethra. Hæmorrhagia spots on the skin. No urethral discharge. External urethral orifice and scrotum, excoriated. Roentgen-ray examination of the genito-urinary tract, negative. Examination of blood shows 15,500 leucocytes.

Patient's mental condition rapidly became worse; more and more drowsy. Death occurred 3 days after admission to hospital. Permission for a complete autopsy could not be obtained. Autopsy revealed the following findings:

The spleen was enormously enlarged and showed the presence of many infarcts (chronic septic spleen). Liver was negative. Both kidneys indicated the presence of a very severe hæmorrhagic nephritis; many recent infarcts. An abscess was found in the prostate and there was a very large abscess around the prostate. Many ecchymoses of the skin.

From the autopsy findings it seemed justifiable to assume that the patient was suffering from a general sepsis and that the abscess in and around the prostate was a part of his general sepsis.

SYMPTOMS

Once the abscess has developed, there does not appear to be any difference in the symptomatology, in the venereal and nonvenereal cases, except as regards the presence of an acute or chronic discharge. An analysis of the more common symptoms shows that they were present in both groups. For this reason they will be considered together.

Frequency of urination. This was present in 34 of the 43 cases. Although the most constant of all urinary symptoms present, frequency of urination varied greatly in its intensity in the individual case. Thus, where in some cases there was only a slight increase in frequency, in others it was so well marked that the patients were obliged to void every 2 hours, both day and night. In 7 cases the patients were obliged to void every 15 to 30 minutes, both day and night.

Pain. Pain in one form or another was almost constantly present. Thirty-six of the 43 cases had pain. In some the pain, which was suprapubic, was present only when the bladder was distended; relief came promptly with catheterization. Perineal pain was present in 11 cases, in 14 the statements made indicated perineal fullness associated with pain.

Pain, associated with or aggravated by micturition, characterized 22 cases. In some the pain was present before, and in others both before and after, urination. In some the pain was in the neck of the bladder, and in a small number it was referred to the lumbar region.

Retention of urine. In 14 cases in this series complete retention of urine occurred; hence, catheterization before or after admission to the hospital was carried out. Practically all 14 cases came to the hospital seeking relief from retention. The duration of the retention was variable. In one case retention was present a fortnight prior to admission. This was the longest duration of retention in this series. The following duration was noted in the remaining cases: 8 days—1 case; 7 days—3 cases; 3 days—1 case; 2 days—4 cases; 1 day—1 case; 12 hours—1 case; and in 2 cases the catheter was used only once. Of these 14 cases, 8 instances of retention were complications of gonorrhœa and the remaining 6 occurred in nonvenereal cases. In these 6 cases, the retention occurred under the following circumstances:

(1) Previous operation for appendicitis; (2) osteomyelitis of finger; (3) carbuncle of neck; (4) passage of sounds; (5) benign hypertrophy; (6) no cause found.

Difficult urination. Synchronously with an abscess in the prostate there occurs a definite enlargement. As a result of this, one would naturally expect some difficulty in urination in a certain number of cases. In this series there were 23 cases in which this difficulty was more or less characteristic.

Rectal symptoms. These symptoms occurred in 25 cases and were described as painful defæcation in 10 cases. Pain in the rectum was a disturbing element in 11 cases, and abnormal sensations, such as a feeling of warms or fullness, were complained of in 2 cases. Ten cases were free from rectal symptoms. In 9 cases no record of the presence or absence of rectal symptoms was noted.

Of the 25 cases presenting rectal symptoms, 20 were due to abscess of gonorrhœal origin and 5 were nonvenereal.

Chills and fever. Nineteen cases were subject to these disturbances.

Rectal findings. In all the cases definite changes in the prostate were elicited upon rectal examination. In each case rectal examination gave evidence of pain and tenderness in the prostate as well as changes in size and consistence.

In the well advanced or well developed cases of abscess, the diagnosis is easy. In the early cases, in which the abscess is small, that is, before there has been much destruction of prostatic tissue, there may be some doubt about the diagnosis. In several cases the presence of a definite circumscribed area of pain and tenderness was of assistance as regards recognizing the cases early and permitting early surgical intervention. When the abscess is large, fluctuation can readily be elicited.

In 13 cases rectal examination revealed the location of the abscess in the left lobe, and in 10 cases in the right lobe. In the remaining cases no specific reference to one lobe or the other was noted.

COURSE

The three possible terminations of an abscess of the prostate are (1) resolution, (2) rupture, (3) operation.

One case left immediately after the diagnosis was made and further data were not obtainable. Two cases were found at autopsy.

1. Resolution. In this series there were only 4 cases that went on to resolution. Thus it will be seen that the total number of cases that go on to resolution is small.

2. Rupture. In 19 cases the abscess ruptured into the urethra. The factors which were associated with rupture were variable. Some ruptured spontaneously, or while straining at stool; some without any apparent factor being present as the cause; and others during rectal examination, although the examination was made carefully and without undue force.

In several instances the amount of pressure exerted by the finger in the rectum was increased in order purposely to cause the abscess to rupture into the urethra. Needless to state, this is not practiced or recommended as a routine procedure.

In 1 case the abscess pointed alongside the rectum; hence, it might easily have been mistaken for an ischiorectal abscess.

When an abscess of the prostate points alongside the rectum or when it appears above the symphysis pubis, it should no longer be considered a true abscess of the prostate. Some authorities are of opinion that this sort of abscess is a periprostatic suppuration or phlegmon, but most authorities call it a periprostatic abscess. Averseng and Dieulafoy have made exact anatomical, experimental, and pathological studies upon the site and upon the sheath-investing membrane of the prostate, and, according to their findings, have demonstrated that besides the prostatic capsule, as they call it, there is a periprostatic aponeurosis, arranged in such manner that interspaces are formed in front, laterally, and behind the prostate, which are of great importance, since they may be the seat of isolated abscess formations. According to these authors, true periprostatic abscesses lie within the prostatic aponeurosis, between the latter and the prostatic capsule, and originate through direct contact with suppuration of the gland. Abscesses situated outside the aponeurosis in the cavum retzii, in the perirectal space, etc., arise from extension of infection by way of the lymphatic vessels and the veins. They do not form encapsulated abscesses, but appear as diffuse phlegmons. These anatomical relations point to the necessity, when opening a periprostatic abscess, of making sure that no other encapsulated abscesses are present in the interspaces above described. Blum reports 1 case in his series in which the abscess appeared as an enormous tumor over the symphysis, simulating a distended bladder.

3. Operation. Sixteen cases were operated upon and no operative deaths were recorded.

One of the abscesses was opened through the rectum by the local physician; the abscess was very large and protruded into the rectum; hence, it was a simple procedure. Formerly, this route was the one resorted to very often and very freely; at present it is rarely, if ever, used. The patient made a prompt recovery and there were no unpleasant sequelæ.

As mentioned above, one of the abscesses pointed in the ischiorectal fossa. This was opened by an incision alongside the rectum, just as in any other ischiorectal abscess.

The remaining 14 cases were operated upon by the perineal route. The usual lateral incision employed for perineal prostatectomy was used. The abscess in the prostate was incised with a scalpel or occasionally the abscess was opened by thrusting into it a pair of blunt pointed forceps. The urethra was not opened; it was our object to avoid opening the urethra and in this way prevent a urinary fistula which would prolong convalescence. At the present time the perineal method of draining prostatic abscesses is the method of choice. Care should be exercised, after opening the abscess to insure thorough drainage; that is, to preclude the possibility of another abscess being left behind. To this end the septa between the abscesses should be broken down with the finger.

If the abscess is located in only one lobe, that lobe only is opened. If both lobes are involved, both are incised at one sitting.

The treatment of abscess of the prostate does not differ from the treatment of an abscess in any other organ, where the dictum is to make the diagnosis early and to drain.

Perhaps the policy of watchful waiting has been instituted and encouraged, because a large number of cases tend to rupture into the urethra, if one waits long enough. This delay—waiting for something to take place—must necessarily be at a certain expense of the prostate; for if our object is to conserve the functions of this organ, it would appear the right sort of treatment to make the diagnosis early—namely, before much destruction of gland tissue has taken place and then to institute proper surgical intervention. Furthermore, spontaneous rupture may, at times, be insufficient for proper drainage; hence, an infected cavity remains which may be the cause of a chronic discharge or of subsequent attacks of abscess formation.

One case developed epididymitis after the operation, and another, an urethral fistula on the third day after the operation. This was entirely healed at the time the patient left the hospital.

One factor which seems to be of sufficient importance to discuss, is the importance of the after-care of the patient after the abscess has healed. Our method has invariably been not to dismiss the patient as cured because the abscess was healed.

Careful massage of the prostate followed by microscopic examination of the strippings revealed the presence of pus. In view of this fact, it would appear important that these patients should be carried through to a point where the prostatic strippings are free of pus. This has been our routine—at least, we have attempted to carry it out whenever the patient would co-operate with us.

Our duty toward a patient is not fulfilled, and remissness obtains, if we allow him to leave so long as the prostatic strippings still show pus. At times, one meets with a patient who is surprised to learn that further treatment is necessary after the operation—a procedure which is not readily understood by him, since he regards the operation all that is necessary to effect a cure.

SUMMARY

1. Abscess of the prostate occurs more frequently than is generally recognized.

2. Infected abscess cavities, which drain poorly and have ruptured into the urethra, may occasionally be factors in keeping up a chronic urethral discharge, or may lead to recurring exacerbations of acute prostatitis.

3. Nongonorrhœal abscess is not an uncommon occurrence.

4. Early surgical intervention—namely, incision and drainage, is a rational method of handling these cases and does not differ from the surgical treatment of abscess occurring in other organs.

5. Operative treatment doubtless shortens the duration of the disease.

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PREGNANCY WITH DEATH OF THE FŒTUS AND FAILURE OF EFFORTS AT SPONTANEOUS DELIVERY, RESULTING IN MACERATED FŒTUS AND PERFORATION OF ABDOMINAL WALL; OPERATIVE REMOVAL; RECOVERY

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WE recently received a case on our surgical service, General Hospital No. 20-807, which is of sufficient interest to justify its being placed on record. In a country such as China a medical practitioner constantly sees cases that have been neglected for weeks or months, partly through ignorance and partly through fear of western methods. The thing that constantly surprises one seeing such cases is the fact that they survive. The outdoor life led by the country people, men and women being out of doors practically the whole time 8 or 9 months a year, and their houses being of such construction that they secure fair ventilation, even against their will the remaining months, undoubtedly has very much to do with their ability to resist infection. This case is a striking example of what the human organism can stand and is also interesting from a diagnostic standpoint. A history giving the essential points is herewith presented:

The patient, a young country woman 26 years of age, was admitted to the Kashing Hospital, on July 21, 1920. Her family history and her personal history prior to the beginning of the present trouble are not recorded, except that she is married and the mother of two healthy children.

Present illness. As to the date of her last menstrual period the patient is not perfectly clear, but from her statements it occurred some time during the month of December, 1918. A pregnancy which seemed in all points normal dated from this time and continued until some time between the 20th and 25th of September, 1919, when fœtal movements ceased. Following this about one week, the membranes ruptured, there being a "great rush of water," and a midwife was called. She expected labor to set in. This, however, was delayed until October 7, when pains, which she describes as being true labor, commenced. To use her words, however, the pain lasted only "half a night." She does not give a history of exceptionally severe pain, nor is there any history pointing to severe shock. She states that the vulva became much swollen. No blood was passed until 2 days later when she passed considerable amounts of blood and a white cheesy material which she likened to "bean curd" (very similar to thick clabber). She passed material of this nature by vagina for 3 months. During this time the vulva was constantly swollen. After 3 months and until admission no blood was passed, but there was a constant purulent, offensive discharge. About 7 weeks before admission the abdomen opened spontaneously and about 2 weeks prior to admission a bone fragment was passed. The day before admission a second bone fragment was passed through the abdominal opening.

Physical examination. The patient is a young, frail looking woman, evidently quite sick. On inspection the abdomen showed a wound in the right iliac fossa, parallel to and about 2.5 inches above Poupart's ligament. This wound is about 4 inches long. The aperture is filled with a dirty, greyish mass, which on tapping proved to be bone. The lower abdomen is filled with a mass extending to about the level of the umbilicus and well out to the pelvic bones on either side. The abdomen is not markedly tender. The patient was admitted and ordered prepared for operation on the following day. The temperature on admission was 100° F. Urine examination made before operation showed nothing of note. The white blood cells were 9,000. The hæmoglobin was 70 per cent.

The patient was placed on the table in the dorsal position and after the administration of ether the abdomen was prepared with iodine. The wound proving to be sufficiently large to remove the bones of the skull no additional incision was made. After the skull bones had been removed a large cavity filled with fœtal remains was brought into view. This mass of material was rapidly removed manually and the cavity sponged out with hot saline. The cavity was found to extend to the level of the umbilicus and to occupy the whole of the pelvis. Further exploration revealed bone in the midline low down in the pelvis. After some little difficulty this was grasped with an artery forceps and removed. It proved to be a femur. The tibia and fibula were then recovered and digital exploration revealed the small bones of the foot deep in the pelvis. While attempting to seize these with the forceps it was found that they receded deeper. Digital exploration was again made and the finger followed the bones to and through the smooth, rounded external orifice of the cervical canal. This was further verified by having an assistant locate the cervix by vaginal palpation and then passing an instrument through the orifice and bringing it into contact with his hand. The

cavity was then again explored and packed with saline sponges. Owing to the grossly infected nature of the cavity it seemed best not to suture the wound. The patient was returned to the ward in good condition with instructions to be placed at once in the Fowler position.

Following the operation the course of the disease was rather stormy for a few days. The temperature, which was normal the morning of the day of operation, rose to 100.6°F. that afternoon and to 103° F. the following day. At this time the white blood count was 15,000. From this time on, her temperature gradually fell, reaching 99° F. the afternoon of the sixth day after operation. The day after operation there was a large amount of foul fluid discharge, seropurulent in character. After the second week, drainage was discontinued, a clean sinus having developed. The patient was discharged on the thirty-fifth day. At this time the wound had entirely healed except for a small granulating surface which would require only a few days to be covered with skin.

The case presents difficulties in diagnosis. It would seem that the condition found might have had any one of three causes: Ectopic gestation followed by false labor which came on after the death of the fœtus; missed labor with subsequent perforation of the uterine wall; ruptured uterus at time of labor.

In discussing the question of missed labor, Williams in his *Textbook on Obstetrics*, second edition, warns against confusing the condition with false labor in ectopic gestation. Missed labor is defined by Dorland as: "Retention of the dead fœtus *in utero* beyond the period of normal gestation," and seems to be a very rare condition.

When this woman was first seen, in the outpatient department, where she was carried in and placed upon the examining table, and the abdominal wound uncovered, the diagnosis of ectopic gestation with macerated fœtus at once presented itself. That such, however, was not the case seems certain from the history, later secured, of the discharge of amniotic fluid. That is, the condition originally must have been intra-uterine. At the time of operation it was impossible to state positively what the original position of the child had been. It seems perfectly fair to say, however, that it was a breech presentation, this deduction being based upon the position of the head in the right iliac fossa and the finding of leg bones well down in the lower uterine segment.

The fact that the right wall of the uterus was found to be lacking, down to about the level of the internal os, explains the means of escape of the child. It does not tell us, however, the method of rupture, whether a laceration at time of labor, or due to necrosis resulting from infection.

Williams states that the ordinary source of infection in cases of ectopic gestation when the fœtus is retained and becomes macerated, is intestinal. In this case the direct implantation of infectious material into the uterine cavity by the hands of the midwife would seem probable and certainly could not be ruled out. The author believes it possible that the uterine contents were infected by the midwife when first called; that this infection spread to the uterine wall, possibly at the site of implantation of the placenta, and resulted in a slough allowing the escape of the child into the folds of the broad ligament, the process progressing gradually until the condition as seen on admission was produced. This, however, does not seem probable.

Hence the first possibility of ectopic gestation seems ruled out, the second, missed labor, with infection is improbable, and by the process of elimination, we are forced to conclude that it was probably a case of rupture of the uterus. Why the uterus should have ruptured in a case of this kind is not clear. Labor pains were not severe and lasted only a few hours. No history of an infection prior to labor was obtained, but such an infection is a possibility. If the uterine contents were infected and an interstitial infection produced, this might have so weakened the wall as to render that portion less resistant than the cervix, with a resultant rupture, rather than dilatation. Were there such an infectious process it might account in part for the fact that the woman did not die of shock; the pressure resulting from the inflammatory products partially occluding the larger vessels. The fact that the child only partially escaped from the uterus, thus bringing pressure on the lacerated tissues, doubtless was the chief factor in the control of the hæmorrhage.

DEPARTMENT OF TECHNIQUE

A SIMPLE INCISION FOR OPERATIONS ON GASSERIAN GANGLION

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THE first successful intracranial operation for the relief of trifacial neuralgia was performed in 1890. Since that time the technique of the operation has been simplified greatly by the use of specially adapted instruments, particularly the illuminated retractor employed by Adson and by Frazier, and by improvement in the types of incisions introduced, each simpler and less time-consuming than its predecessor. In selecting the incision three important factors should be borne in mind: (1) avoidance of injury to the temporal branch of the facial nerve, (2) ample exposure, and (3) limitation of disfigurement.

Hartley and Krause introduced a horseshoe osteoplastic flap incision with its base immediately above the zygoma, but without resection of the zygoma. The frequent injury to the temporal branch of the facial nerve was the most disappointing feature of this incision.

Cushing suggested a musculocutaneous horseshoe flap incision with its anterior limb sufficiently short to avoid injury to the upper branch of the facial nerve. In this approach temporary resection of the zygoma with removal of bone down to the foramen ovale was advocated. Cushing is now using a musculocutaneous incision without resection of the zygoma. The objection to this incision is the mass of muscle above the zygoma, which interferes with the low approach to the middle fossa.

The question mark incision devised by Frazier has been in common use. The incision is entirely within the hair-line; the anterior limb begins 3 centimeters behind and above the external angle of the orbit. A fascial flap is turned in the opposite direction from that in the scalp, and the temporal muscle is incised in the direction of its fibers. The principal objection to this incision is the possibility of injuring the temporal branch of the facial nerve from retraction or from severance, and the time required in making and in closing it.

The incision used in the Mayo Clinic for the last few months has distinct advantages: (1)

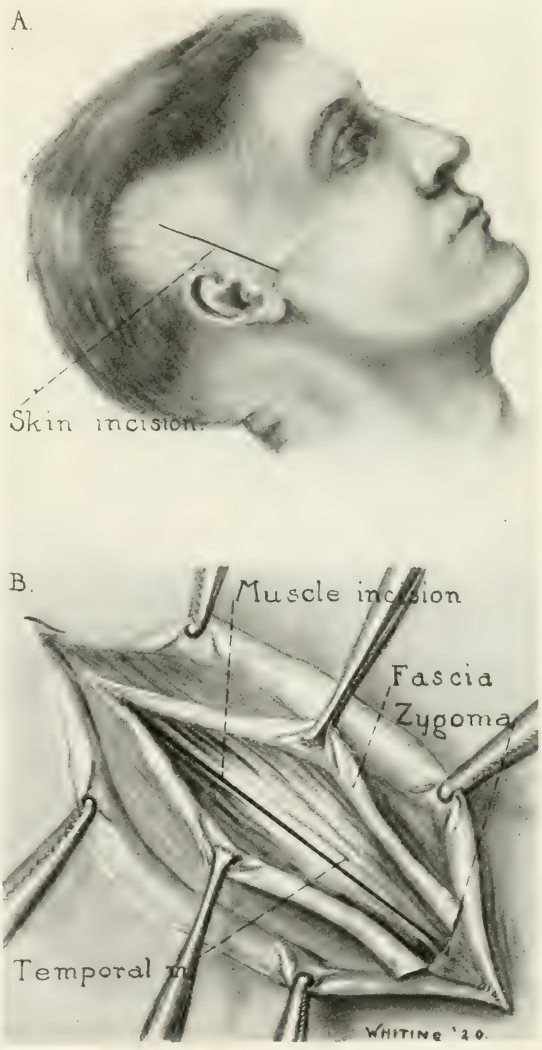

Fig. 1. *a*. Scalp incision beginning at the lower edge of the zygoma and extending upward in the direction of the temporal muscle fibers. *b*. Incision in temporal fascia showing the transverse incision at the lower angle.

[1] From the Section on Neurology, Division of Surgery.

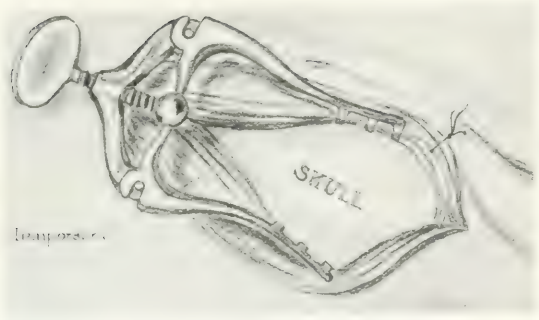

Fig. 2. Self-retaining retractor in place exposing temporal bone.

it is simple and can be rapidly made and closed, (2) it precludes the possibility of injury to the temporal branch of the facial nerve, (3) it is entirely within the hair-line and leaves no visible scar, and (4) it prevents the swelling so prone to occur about the orbit in flap incisions.

The incision begins at the lower border of the zygoma, 1 centimeter in front of the ear, and extends 8 centimeters backward and upward in the direction of the fibers of the temporal muscle. The incision is extended through the skin, fascia, and muscle, but in addition the temporal fascia is divided parallel with the zygoma for a distance of 0.5 centimeter in each direction from the oblique incision, thus affording greater exposure of the lower angle. A self-retaining retractor is used to expose the bone for decompression with removal of bone down to the floor of the middle fossa (Figs. 1, 2, and 3).

Elsberg, of New York, in a personal communication states that he has employed a similar incision with entire satisfaction.

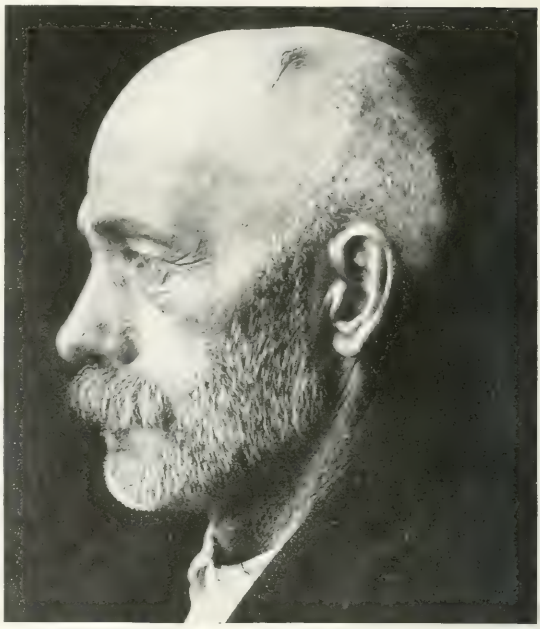

Fig. 3. (A326986.) Photograph of wound 10 days after ganglion operation.

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A PIN METHOD FOR THE APPROXIMATION OF THE FRAGMENTS IN FRACTURED PATELLA

By ARTHUR E. HERTZLER, M.D., F.A.C.S., Halstead, Kansas

A YEAR ago while visiting Dr. G. A. Nickelson, of Plains, Kansas, he showed me a patient on whom he was using a method for the reduction of fractured patella, which he believed was original. I cannot say whether or not the method is original, but if not original I have failed to find a description of it. At any rate the method is not as well known as its merit deserves.

The procedure is as follows: Strong pins are passed through the tendons as close as possible to the patella. The pins are then approximated by means of bandages or adhesive strips (Fig. 2). This brings the broken fragments in close approximation (Fig. 1).

The case from which the above pictures were obtained had the patella fractured in an automobile accident. The fragments were fairly widely separated (Fig. 3). The pins used here were long bone drills. The skin was anæsthetized with novocaine at the point of proposed insertion and the exit of the pins. The drill handle was used to force the pins through.

The pins were at no time complained of and the degree of irritation was at no time noteworthy. The leg was supported by a splint but this was removed from time to time and the knee exercised. Good functional result and bony union resulted.

The advantage of this method is that the bones can be certainly approximated without entering the knee-joint. It is capable of being used, as Dr. Nickelson uses it, far away from the facilities that are essential for an open operation.

Fig. 1.

Fig. 2.

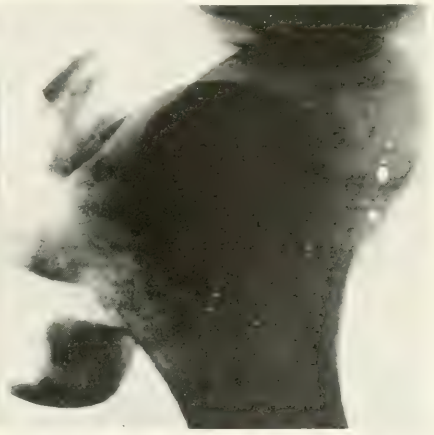


Fig. 3.

Fig. 1. Roentgenogram showing the close approximation of the fragments of the fractured patella after the pins had been drawn together by adhesive as shown in Figure 2.

Fig. 2. The pins are in position and are held together by adhesive.

Fig. 3. Roentgenogram of the patella before the fragments were approximated.

SLING SUSPENSION METHOD OF EXERCISE IN INFANTILE PARALYSIS

By FRED J. GAENSLEN, M.D., F.A.C.S., Milwaukee, Wisconsin

DURING the past months a system of exercises has been employed as an aid in selected cases of infantile paralysis which seems to have sufficient merit to make a report worth while. Briefly, the method consists in suspending the extremities to be exercised in a sling in mid-air to eliminate entirely both gravity and friction as hindrances to the to and fro motion. It is generally conceded that voluntary motion, involving as it does physiological exercise of the entire neuromuscular mechanism, is of vital importance in restoration of muscle power. Any method, therefore, which facilitates this function, should be of value. In the method to be described very slight muscle power can be translated into actual movement. Morever, very slight gains in power are measured by appreciable increase in the arc of motion. The mental stimulus to both patient and parent or teacher is a factor of importance in enlisting their best efforts in systematic and persevering application to the long and at best tedious task. The method is best adapted to those cases having the merest trace of demonstrable power or at any rate insufficient power to raise the limb against the force of gravity, or to move it against the friction of the examining table. When the weakness is less pronounced graduated resistance may be offered and comparative tests by the spring balance method devised by Lovett can be readily carried out.

The simplicity of the procedure will recommend it especially in cases where it is not possible to put a skilled nurse in charge. At the first examination of the patient, the weak muscles or muscle groups are determined and in a few minutes the special exercises necessary can be demonstrated so that anyone of average intelligence will understand them sufficiently for the carrying out of the work at home. Careful supervision by the physician of course is desirable so that modifications may be instituted in the carrying out of the exercises, to meet the special needs. The details of the method are perhaps best described by referring to the photographs.

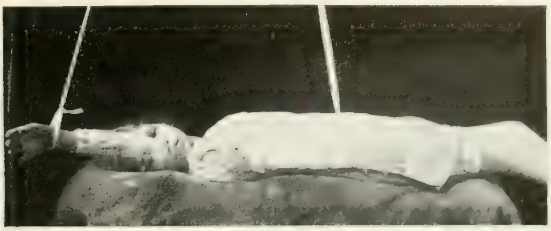
Figure 1 shows the patient in position for exercising flexors and extensors of the hip. A broad cuff fixes the knee-joint. The extremity is suspended in a sling about the ankle and the patient is directed alternately to flex and extend the limb at the hip.

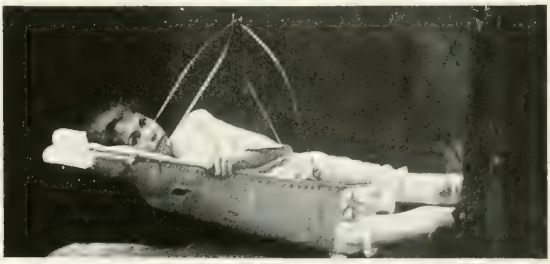
Figure 2 shows the patient in position for exercising the muscles controlling the knee-joint. The patient is seen lying on the left side, the sling under the right ankle (negative reversed in printing). The thigh above the knee is fixed either by the patient himself or by the instructor, and the patient alternately flexes and extends the knee. In order to avoid overstretching of the weakened quadriceps muscle, motion should be stopped at the position of 45° of flexion. Exercises 1 and 2 may be combined by using two slings, one just above the knee and the other about the ankle. In this way provision is made for flexion and extension of the knee alternating with the same motion for the hip, the knee being held fixed. When the knee is not fixed, flexion of both knee and hip may be carried out at the same time followed by extension at both joints, the motion resembling the alternate drawing up of the legs and kicking as in swimming. It may also be of advantage to do all of the above exercises in sequence, first flexion and extension of the knee, then flexion and extension of the hip with the knee extended, followed by combined flexion of the knee and hip and finally extension of both knee and hip. The slight pause will be of advantage for the individual groups. Rest periods should of course be insisted upon to prevent fatigue of muscles.

Figure 3 shows the patient in position for abduction and adduction at the hip. The patient lies on the back and the slings are passed about the ankle. In some cases it will be necessary to apply another sling about the knee to prevent hyperextension at the knee from gravity. Foot drop may be prevented by replacing the sling about the ankle by a special foot support.

Figure 4 shows the patient in position for flexion and extension at the elbow. The sling is applied about the wrist. The arm above the elbow is fixed by the patient or by the instructor. By shifting the sling to support the hand, flexion and extension of the wrist is facilitated.

Figure 5 shows the arrangement for forward and backward elevation of the arm. When the deltoid is weak these exercises should be done





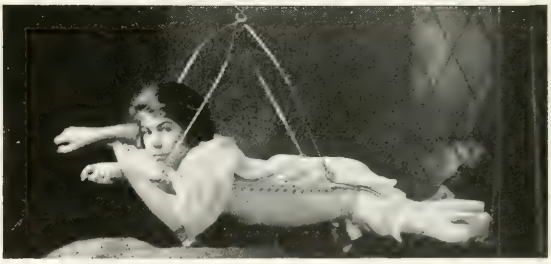


Fig. 1. Position of patient and arrangement of sling for exercising flexors and extensors of hip. A broad cuff prevents flexion of knee. Two views taken on same plate.

Fig. 2. Arrangement for flexion and extension at knee. Thigh should be fixed by instructor or patient. Two views taken on same plate.

Fig. 3. Arrangement for exercising of abductors and adductors of thighs. Two views taken on same plate.

Fig. 4. Arrangement for flexion and extension at elbow. Upper arm fixed by instructor or patient.

Fig. 5. Arrangement for abduction and adduction of arm. Elbow fixed by means of cuff. Two views on same plate.

Fig. 6. Arrangement for forward and backward elevation of arm. Elbow fixed with broad cuff. Two views on same plate.

Fig. 7. Arrangement for flexion and extension of trunk on pelvis. Lower extremities should be fixed by instructor. Hammock should support thoracic portion of trunk only.

Fig. 8. Arrangement for exercising of muscles controlling lateral flexion of trunk. Hammock should support thoracic portion of trunk only.

with the arm maintained in slight abduction to prevent overstretching of the deltoid.

Figure 6 shows the patient in position for rotation at shoulder. When the deltoid is paralyzed the arm should be in a partially abducted position to prevent overstretching of the deltoid.

Figure 9 shows the position used in abduction and adduction of the arm. A broad cuff is applied about the elbow to provide fixation, while another supports the wrist.

Figure 7 shows the patient lying on the side, the trunk suspended in a hammock, for flexion and extension of the trunk and the hips. This hammock should be shorter than is shown in the illustration so that only the upper portion of the trunk is suspended, the legs being supported on a

Fig. 9. Arrangement for rotation inward and outward of arm at shoulder. Two views on same plate.

table or held by an assistant. In this way greater freedom of motion is secured for the erector spinæ and abdominal muscles.

Figure 8 shows the patient lying prone with the trunk suspended in the hammock and the legs fixed by assistant for the exercise of the muscles involved in lateral bending of the spine.

The alternate rhythmic contraction and relaxation of muscle groups and their respective antagonists as provided in the method outlined above is of advantage since it resembles in a way the action of muscles used in such exercises as walking. The same is true of the character of the motion, it being slow at first, more rapid in the middle phase, and slow again toward the completion of the movement.

The muscle power involved is very slight, so that there is little danger of fatigue, even if frequently repeated through the day. Overstretching of muscles should be prevented by limiting the arc of motion. It is also likely that the method can be applied earlier than other methods because of the gentleness of the movement and furthermore it can be used in cases of very young children who will co-operate in these simple swinging exercises when muscle training of the usual type is impracticable. In older children these exercises may be adjusted to their capabilities by offering resistance, or by asking them to do them on the count rather than pendulum fashion. The method is naturally not applicable to muscles controlling movements of fingers and toes, but rather to those controlling the larger joints. In a number of cases the observation was made that circulatory disturbances as shown by cold and clammy extremities were beneficially influenced in a comparatively short time. It is perhaps needless to say that exercise methods in infantile paralysis form but a part of the treatment. Massage, heat, supportive appliances, and operative procedures all have their proper place.

PLASTER ROPE CAST

An Efficient Splint for Infected Fractures of the Leg

By ARCHIE EWING GORDIN, M.D., Jackson, Mississippi
Attending Surgeon, Mississippi State Charity Hospital

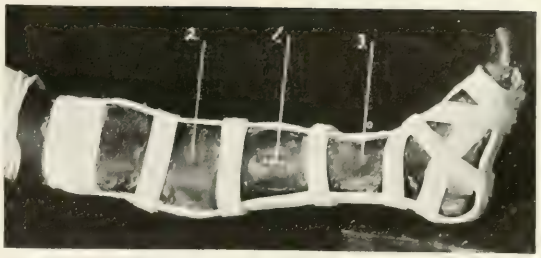
I HAVE endeavored for some time to find some form of plaster cast which could be used efficiently in such cases as compound infected fractures of the leg, certain osteomyelitis cases, and other conditions where immobility as well as drainage is required. I have used nearly every form of cast and splint, but recently on my service in the Mississippi State Charity Hospital I have been using a plaster cast composed of a number of plaster ropes, and have found this a most efficient splint in such cases.

The rope cast is made of six-inch plaster bandages. A bandage is folded upon itself several times, and is then folded lengthwise three times, so as to make a flattened plaster rope about 10 to 15 layers thick (see Fig. 1). These ropes are thus made strong enough to stand a considerable strain.

I usually mold one rope to the anterior surface of leg and one to the posterior surface, and at various intervals where there are no raw surfaces or discharging wounds, I wind plaster ropes around the leg. Usually about four ropes around the leg will hold it very firmly. Almost any modification can be made to suit individual case.

An ordinary plaster cast is not efficient in such cases, for even where an opening is cut in the cast, the discharge runs behind the plaster macerating the skin, and also softening the cast. The rope cast has answered very satisfactorily. I have been able to keep the leg very dry and clean, easy access to the wound is afforded, and it is possible to keep the leg well immobilized.

Figure 1 shows a cast made of plaster ropes which has been in place 5 weeks. It is in as good condition as when put on. This case was an acute infection of a compound fracture: the leg was



incised in four places, the incisions being between the plaster ropes as shown in the picture at *1*, *2*, *3*, and on the opposite side of leg. The original fracture was at *1*. The wounds healed and on removal of the cast, there was found good union of the bones. In this case the plaster ropes were reinforced with small steel wire. This cast is especially recommended for use in children.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

ANNALES DE LA CLINIQUE CHIRURGICALE DU PROFESSEUR PIERRE DELBET. No. 7—Fractures du Col du Fémur. By Antoine Basse. Paris: Librairie Félix Alcan, 1920.

LECCIONES CLÍNICAS DEL SÁBADO—LA LITIASIS BILIAR EN LA REPÚBLICA ARGENTINA. By Luis Agote. Buenos Aires: L. J. Rosso y Cia, 1920.

THE STORY OF THE AMERICAN RED CROSS IN ITALY. By Charles M. Bakewell. New York: The Macmillan Co., 1920.

HELPING THE RICH. By James Bay. New York: Brentano's, 1920.

BACKWATERS OF LETHE; SOME ANÆSTHETIC NOTIONS. By G. A. H. Barton, M.D. New York: Paul B. Hoeber, 1920.

SYPHILIS. By Loyd Thompson, Ph.B., M.D. 2d ed. thoroughly revised. Philadelphia and New York: Lea & Febiger, 1920.

THE SYSTEMATIC TREATMENT OF GONORRHŒA IN THE MALE. By Norman Lumb, O.B.E. 2d ed. Philadelphia and New York: Lea & Febiger, 1920.

SURGERY, ITS PRINCIPLES AND PRACTICE; for students and practitioners. By Astley Paston Cooper Ashhurst, A.B., M.D., F.A.C.S. 2d ed. Philadelphia and New York: Lea & Febiger, 1920.

SURGERY; A TEXTBOOK BY VARIOUS AUTHORS. Edited by George E. Gask, C.M.G., D.S.O., F.R.C.S.(Eng.), and Harold W. Wilson, M.S., M.B.(Lond.), F.R.C.S. (Eng.). London: J. & A. Churchill, 1920.

THERAPEUTISCHES VADEMEKUM FUER DIE KINDERPRAXIS. By Dr. Hans Kleinschmidt. Berlin: S. Karger, 1920.

DIE WURMFORTSATZENTZUENDUNG; eine pathogenetische und histologische Studie mit besonderer Beruecksichtigung der Bedeutung der Helminthen, speziell der Oxyuren, und wichtiger allgemeiner klinischer Gesichtspunkte. By Dr. A. Rheindorf. Berlin: S. Karger, 1920.

INJURIES OF PERIPHERAL NERVES. By Henry S. Souttar, C.B.E., F.R.C.S.(Eng.), M.Ch.(Oxon.), Major, ex.-R.A.M.C., and Edward W. Twining, M.R.C.S., L.R.C.P. (Lond.), Captain, ex-R.A.M.C. New York: William Wood & Co., 1920.

DEFECTS FOUND IN DRAFTED MEN; Statistical information compiled from the draft records showing the physical condition of the men registered and examined in pursuance of the requirements of the selective-service act. Prepared under the direction of the Surgeon-General, M. W. Ireland, Major General, M.C., U.S.A., by Albert G. Love, M.D., Major, M.C., U.S.A., and Charles B. Davenport, formerly Major, M.C., U.S.A. Washington: Government Printing Office, 1920.

BLOCK ANÆSTHESIA AND ALLIED SUBJECTS WITH SPECIAL CHAPTERS ON THE MAXILLARY SINUS, THE TONSILS, AND NEURALGIAS OF THE NERVUS TRIGEMINUS; for oral surgeons, dentists, laryngologists, rhinologists, otologists, and students. By Arthur E. Smith, D.D.S., M.D. St. Louis: C. V. Mosby Company, 1920.

VENEREAL DISEASES; THEIR CLINICAL ASPECT AND TREATMENT. J. E. R. McDonagh, F.R.C.S. St. Louis: C. V. Mosby Co., 1920.

COLLECTED PAPERS OF THE MAYO CLINIC, ROCHESTER, MINNESOTA. Edited by Mrs. M. H. Mellish. Vol. XI, 1919. Philadelphia and London: W. B Saunders Co.

THE ENDOCRINES. By Samuel Wyllis Bandler, A.B., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Co., 1920.

THE FORM AND FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM: an introduction to the study of nervous diseases.

By Frederick Tilney, M.D., Ph.D., and Henry Alsop Riley, A.M., M.D. New York: Paul B. Hoeber, 1920.

Psychopathology. By Edward J. Kempf, M.D. St. Louis: C. V. Mosby Co., 1920.

Clinical Lectures on Enlargement of the Prostate; with a description of the author's operation of total enucleation of the organ. By Sir Peter J. Freyer, K.C.B., M.D., M.Ch., M.A., LL.D.(honoris causa) Nat. U. I.

Transactions of the Southern Surgical Association. xxxii, 1919. Edited by H. A. Royster, M.D., 1920.

Nitrous Oxide-Oxygen Analgesia and Anæsthesia in Normal Labor and Operative Obstetrics. Edited by F. H. McMechan, M.D. Published by National Anæsthesia Research Society, 1920.

Surgical Pathology and Morbid Anatomy. By Sir Anthony A. Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., and Sir Frederick W. Andrewes, M.D., F.R.S. 7th ed. Philadelphia: P. Blakiston's Son & Co.

The Anatomy of the Human Skeleton. By Ernest Frazer, F.R.C.S.(Eng.). 2d ed. Philadelphia: P. Blakiston's Son & Co., 1920.

Anæsthetics; Their Uses and Administration. By Dudley Wilmot Buxton, M.D., B.S. 6th ed. Philadelphia: P. Blakiston's Son & Co., 1920.

Report of the Surgeon General, U. S. Army, to the Secretary of War, 1920.

Mortality Statistics, 1919. Bulletin No. 144—Department of Commerce, Bureau of the Census, Sam. L. Rogers, Director. Washington, 1920.

The Difficulties and Emergencies of Obstetric Practice. By Comyns Berkeley, M.A., M.D., M.C. (Cantab.), F.R.C.P.(Lond.), F.R.C.S.(Eng.), and Victor Bonney, M.S., M.D., B.Sc.(Lond.), F.R.C.S.(Eng.), M.R.C.P.(Lond.). 3d ed. Philadelphia: P. Blakiston's Son & Co., 1921.

Proceedings of the Fourteenth Annual Meeting of the Association of Life Insurance Presidents, New York, December 9 and 10, 1920.

Transactions of the Nineteenth, Twentieth, and Twenty-First Annual Meetings of the American Proctologic Society, New York, June 4 and 5, 1917; Atlantic City, June 7 and 9, 1919; and Memphis, April 22 and 23, 1920.

United States Naval Medical Bulletin. Published for the Information of the Medical Department of the Service. Mare Island Hospital Number, January, 1921.

Oedema Agudo O Subagudo del Brazo (Thrombosis Venosa por Esfuerzo). By Alejandro J. Pavlovsky, 1920.

Surgical Therapeutics and Operative Technique. By E. Doyen. English edition prepared by the author in collaboration with H. Spencer-Browne, M.D.(Cantab.), etc. Vols. II and III. London: Bailliére, Tindall & Cox, 1920.

A Synopsis of Surgery. By Ernest W. Hey Groves, M.S., M.D., B.Sc. (Lond.), F.R.C.S.(Eng.). 5th ed. New York: William Wood and Co., 1920.

Surgery of the Lungs and Pleura. By H. Morriston Davies, M.A., M.D., M.C.(Cantab.), F.R.C.S.(Eng.)., Hon. Captain, R.A.M.C.(T.). New York: Paul B. Hoeber, 1920.

Diseases of the Ear. By Philip D. Kerrison, M.D. 2d ed. Philadelphia and London: J. B. Lippincott Co., 1920.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

SURELY the axiom "Qui excuse s'accuse" does not hold good for the reviewer who prefaces a critique of two admirable historical volumes with an apology for including them in a general discussion devoted to purely surgical volumes. 'Tis true, and pity is 'tis true that to most of us medical history is caviar, when it really should be mother's milk. Culture, poise, polish, and perspective—all highly desirable attributes—may be won in many and diverse ways; but the medical man may write it down as certain that in no surer fashion can he make these virtues his own than by knowing the intimate history of his guild.

Such thoughts are inspired by the recent perusal of two volumes—one devoted to the history of anatomic illustration,[1] and the other to the life of Paracelsus.[2]

The History and Bibliography of Anatomic Illustration is in the nature of a memorial edition. The editor, the late Dr. Mortimer Frank, so well known for his contributions to medical history, died before his manuscript was set up in type. A memorial committee saw to it that the book did not die aborning; and more than this, two pre-eminently qualified members of the committee have graced the volume with two additional chapters.

The introductory chapter by the editor is devoted to a short life of Choulant. Due to a highly refined sense of selection on the part of Dr. Frank, this chapter relates not only the historical achievements and bias of Choulant, but also his relationships to the development of medicine during the early nineteenth century. Choulant was contemporaneous with Sprengel, Blumenbach, Littré, Daremberg, and Wunderlich. Dr. Frank, in the compass of a few pages, relates most entertainingly the development of the old medicine into the new, with Choulant unhappily buttressing the outworn, and opposing the new and ultimately victorious, doctrines. The meat of this chapter should be part and parcel of the consciousness of every medical man.

The rest of the volume, which is more academic in character and which makes therefore a less direct appeal to the casual medical reader, is devoted to short biographic and bibliographic notes on the various anatomists and artists who have contributed to the development of the illustrative and artistic side of anatomy. The illustrations, abundant in number, are all taken from such inaccessible sources, that they make a unique appeal; and the academic thoroughness which characterizes practically every line of type makes the book a prize possession even for him who may claim no place among the cognoscendi.

In addition to all this Dr. Fielding H. Garrison and Dr. Edward H. Streeter have added a chapter on "Sculpture and Painting as Modes of Anatomical Illustration," which vies in method of handling with the work of Choulant himself. Finally Dr. Garrison contributes a closing chapter on "Anatomical Illustration since the Time of Choulant," which is a gem of thoroughness lightened here and there with short, clear, cameo-cut explanatory notes.

The reviewer's best wish for the New Year is that a renaissance of historical taste will occur, Minerva-like, and result in the demand for a second and then further editions of this valuable book.

The *Paracelsus* by Stillman is a different sort of a volume. Most of us know old Bombastus, and never tire of reading of his conflicts, polemics, and perigrinations. We read Stillman's version with interest because he has parceled out his material so lucidly and rationally.

Dr. Stillman, himself a chemist and not a physician, has seen to it that full exposition is made of the work of Paracelsus in the field of chemistry; but with admirable restraint and a very fitting sense of proportion this is not unduly stressed. Indeed, little more is said about Paracelsus' accomplishments in the field of chemistry than about his views on theology or pertaining to the ethics of medicine.

The book is entertainingly written; its authoritative character is vouched for by the fact that Stillman has followed very closely the painstaking researches of Schubert and Sudhoff, Huser, and Hartmann. Withall, however, the author practices independent judgment sufficiently often to rob the work of that deadly stupor which only too often characterizes the simple rehash of authoritative statements.

The mere facts that Paracelsus has been immortalized by Browning, has been credited with creating modern surgery, has been dubbed the father of Natural Philosophy, has been supposed to be the inspirer of Goethe's *Faust*, and will always

[1] HISTORY AND BIBLIOGRAPHY OF ANATOMIC ILLUSTRATION IN ITS RELATION TO ANATOMIC SCIENCE AND GRAPHIC ARTS. By Ludwig Choulant. Translated and edited by Mortimer Frank, B.S., M.D. Chicago: University of Chicago Press, 1920.

[2] THEOPHRASTUS BOMBASTUS VON HOHENHEIM CALLED PARACELSUS; HIS PERSONALITY AND INFLUENCE AS PHYSICIAN, CHEMIST, AND REFORMER. By John Maxson Stillman. Chicago and London: The Open Court Publishing Co., 1920.

(rightly or wrongly) be credited with being the arch mystic—all these should inspire even the busy practitioner to want to thumb through this little volume. M. G. Seelig, M D.

DR. BOSCH ARANA'S book[1] is an exhaustive historic, experimental and clinical exposé of cineplastic amputations and an accurate analysis of the many more or less successful attempts to "vivify" artificial limbs. The author is to be commended for his absolute sincerity as well as his modesty. He frankly gives full credit to Dr. Guiliano Vanghetti, of Empoli, Italy, for his original description of cineplastics in 1898; and, in the main, follows the technique of Pellegrini, of Florence, or that of Sauerbruch. The author's personal contribution to this important subject consists in a detailed report of twenty clinical cases, a description of various modifications in operative technique and a presentation of extremely ingenious mechanical hands and feet capable, so he states, of being vivified by muscle traction.

Particularly striking, however, is the extraordinary patience and perseverence manifested by surgeon and patient to obtain a more or less dependable cineplastic contraction of from 1 to 3 centimeters! Dr. Bosch Arana's attempts to obtain alternating flexor and extensor traction in his cineplastic motors must necessarily arouse skepticism; from a purely physiological viewpoint, this desideratum would seem impossible of attainment.

Among his "conclusions" are the following which are well worth remembering:

1. The epidermization of a cineplastic motor is a problem which has not yet been satisfactorily or conclusively solved.

2. Cineplastic motors should be either of the club or ring types; the former is more apt to epidermize satisfactorily.

3. In the present state of cineplastic surgery, the sacrifice of an articulation in order to obtain a motor club or ring is unjustifiable.

4. Immediate prevention of muscle retraction (of an amputated limb) is of no practical advantage; postoperative measures having the same object in view are of great value.

The work is manifestly that of an enthusiast who has devoted an immense amount of time and thought to a subject which has been given a new impulse through war mutilations.

Dr. Bosch Arana's book can be highly recommended to surgeons who wish to study the subject of cineplastic amputations. Both descriptive technique and illustrations are excellent; a series of moving-picture photographs enable the reader to follow the results obtained in some of the author's cases. Finally, the Spanish language should offer no difficulties to the surgeon whose Latin groundwork has not been neglected.

George de Tarnowsky, M.D.

[1] Las Amputaciones Cineplasticas. By Dr. Guillermo Bosch Arana, Buenos-Aires, 1920.

A VALUABLE collection of personal cases operated upon and exhaustively analyzed by the author and his pupils is found in *Clinica Quirurgica y Tecnica Operatoria*.[2] Of special interest may be mentioned 15 cases of tropical abscess of the liver with 14 cures and 1 death from hepatic insufficiency. Classical drainage of the abscess via either the anterior or transpleural routes is followed by the administration of 4 to 6 centigrams of emetine hydrochloride hypodermatically and of an equal quantity into the abscess cavity itself; the combined doses are repeated daily for 6 days, followed by an interval of 1 week or more. This technique, according to the author, avoids the appearance of the peripheral neuritides reported by various clinicians and is a departure from the Roger treatment (*Journal de Chirurgie*, May, 1914), which simply consisted in aspiration of the abscess followed by the injection of from 6 to 10 centigrams of emetine hydrochloride in 30 to 40 cubic centimeters of sterile water.

For operations on the liver and biliary passages, the author describes his own incision, based on anatomical grounds, which avoids injuring the costal nerves. Beginning slightly below the ensiform appendix, he makes a vertical incision, 8 centimeters long, through the linea alba then arches upwardly and outwardly toward the tenth costal cartilage. He claims that the second part of his incision parallels both nerves and intercostal arteries, thus avoiding both.

Three personal cases of pseudomyxoma of the peritoneum of appendicular origin, are reported, corresponding in type to the morbus gelatinosus peritonei of Péan. In his opinion, a pre-operative diganosis of this curious pathological condition is well-nigh impossible to make.

An interesting case of fibrosarcoma of the ovary in a ten-year old girl, with no metastases 4 years after operation, bears out the well-known fact that neoplasms of the ovary are readily curable by operation.

There are chapters devoted to chronic pancreatitis of biliary origin diagnosed by the Gammidge test, acute perforations of gastric ulcer, ureterorenal lithiasis, extirpation of an axillary aneurism (the author's case was really not an aneurism but a traumatic hæmatoma following a gunshot wound of the axilla), and anatomic researches in deep vasculonervous surgery of the neck. The bibliography is extensive and the illustrations are unusually good.

George de Tarnowsky, M.D.

THE development of neurological surgery has steadily progressed during the past decade. The rough, uncouth surgery that characterized its early stages is rapidly giving place to procedures carefully studied from anatomical and physiological groundwork. Those who are called upon to deal with this branch of specialized surgery

[2] Clinica Quirurgica y Tecnica Operatoria. By Dr. J. A. Presno y Bastiony, Professor of Anatomy, National University Medical School: Surgeon to the Covadonga Clinic, etc. etc. Havana, Cuba: 1920.

will be especially interested in the Tandler-Ranzi[1] concise monograph of 150 pages dealing with surgery of the brain and spinal cord. The co-authorship of Tandler, professor of anatomy at the University of Vienna, and Ranzi, professor of surgery in the same university, has resulted in a most excellent contribution. The anatomical drawings under the supervision of Tandler have been reproduced in a beautiful manner. The illustrations, many of them in colors, are illuminating and exact. From the book-making standpoint the volume will stand without a superior. The monograph includes an excellent bibliography.

In only one particular will the American surgeon feel that the contribution of his confrères has been neglected and that is in the short description only of resection of the sensory root for trifacial neuralgia, a procedure that with us has largely displaced the more dangerous and no more efficient procedure of removal of the ganglion.

FEW of the profession realize the scope of the more recent branch of medicine known as industrial medicine and surgery. Many physicians believe that to be able to treat an open wound or infection, to reduce a fracture or perhaps to relieve a poisoning case, constitute the greater portion of industrial medicine and surgery. The purely medical or surgical technique displayed in this branch of work is perhaps only 50 per cent of the total obligation. Prophylaxis, which we are taught in medicine and surgery, finds its greatest function in industrial practice. The physician's effort in preventing accident and disease is probably the first phase of his duty.

Routine examination of employees to determine the physical fitness of each and to detect disabilities which would subject the individual to extra hazards, is equally important. Close association between the physician and the safety expert is necessary. Few employers realize that the human body is in reality a highly organized and intelligent machine, which needs supervision in order to maintain maximum efficiency. This maximum efficiency is only obtained from an employee who is physically and mentally fit, and is relieved of any degree of family worries. Consequently the work must of necessity be carried to the home in order to be of greatest benefit. Contagious and infectious diseases among employees is a problem in itself. This leads to the consideration of industrial hygiene and sanitation.

These various elements and constituents of industrial medicine and surgery along with many others are ably treated by Mock[2] in his recent work. There has been a long-felt want for such a treatise; something to guide not only the physician but the employer, the sanitary expert, the safety engineer, and the social service worker.

The text is divided into six chapters, devoted respectively to industrial health service, prevention, industrial medicine, industrial surgery, compensation insurance, medicolegal phases, and reconstruction.

This work should be carefully studied by the physician treating employees in industrial pursuits. It is no less valuable to the employer, upon whom depends to a marked degree the responsibility of putting such an elaborate and economic principle into practice, and by the casualty companies who must yet be taught the crucial lesson that a laborer is a human being, deserving intelligent and skillful medical and surgical attention. J. A. W.

EVERY consulting surgeon realizes the comparative lack of knowledge of the average practitioner regarding diseases of the rectum and anus, and can recall many instances when he has been asked to operate upon a case of hæmorrhoids and has found an existing or far advanced carcinoma. Many of these patients have been operated upon once and at times twice before for so-called hæmorrhoids. On the contrary many unscrupulous men capitalize the so-called "specialty"—diseases of the rectum—and pretend to cure everything from epilepsy to dementia præcox by operating upon, and by treating the anus. This is again more or less directly the result of the ignorance of the average physician regarding diseases of this location. If every physician possessed a fair knowledge of the pathology of this region and put it into practice much of this abuse would cease.

The new edition of Hirschman[3] again brings to the attention of the profession the necessity for careful and routine examination of the rectum and anus. In a sane and concise manner, the author gives an analysis of the diseases about the anus. The text is confined chiefly to diagnosis and those forms of treatment which can be carried out without the use of a general anæsthetic. The present edition elaborates somewhat on work which can be done under local anæsthesia.

It seems to the reviewer that the outstanding idea expressed in the monograph is that a rectal examination should be included in all routine examinations and when such findings warrant, further specific examinations should be made. J. A. W.

INJURIES to the lung and pleura have received much attention during the recent war, the forms of treatment varying in either extreme, viz., expectant treatment and radical thoracotomy with delivery of the lung for operative procedure, the mortality statistics varying very materially with each form of treatment in the hands of various observers. With this in view the methods and re-

[1] CHIRURGISCHE ANATOMIE UND OPERATIONSTECHNIK DES ZENTRALNERVENSYSTEMS. By Dr. J. Tandler and Dr. E. Ranzi. Berlin: Verlag von Julius Springer, 1920.

[2] INDUSTRIAL MEDICINE AND SURGERY. By Harry E. Mock, B.S., M.D., F.A.C.S., Philadelphia and London: W. B. Saunders Company, 1920.

[3] HANDBOOK OF DISEASES OF THE RECTUM. By Louis J. Hirschman, M.D., F.A.C.S. 3d ed., revised and rewritten. St. Louis: C. V. Mosby Co., 1920.

sults of Morelli[1] who had charge of all chest injuries in the 11th Corps of the Italian Army, are of the greatest interest.

In a recent monograph Morelli strikes a key-note in lung and chest surgery. The methods of treatment are the result of a careful study of the physiology of the lung, pleura, and chest wall, as well as the symptoms, produced by injuries to these organs. As the author states in the preface "Accuracy of diagnosis is of fundamental importance in the value of statistics," so it is with the form of treatment to be instituted.

The accurate description of the physiology of the lung, chest wall, and mediastinum, during the act of breathing surely paves the way for a clear understanding of the methods of treatment given later.

The fundamental principles of the treatment advocated and used by Morelli can be expressed very briefly. A lung which is completely collapsed and at rest, will not bleed, will take care of an unusual amount of infection, and will heal promptly. To put a lung completely at rest it must be collapsed. The ideal way to collapse a lung completely is to perform a pneumothorax. In order to maintain a pneumothorax, an open wound of the chest wall must be closed. About these few facts Morelli constructs his method of treatment.

The basic principles were evolved by the late Professor Forlanini in his work on artificial pneumothorax for the treatment of pulmonary tuberculosis and pleurisy, and Morelli, his assistant, has applied them to the treatment of surgical conditions of the lung and pleura.

[1] The Treatment of Wounds of Lung and Pleura Based on a Study of the Mechanics and Physiology of the Thorax. Artificial Pneumothorax, Thoracentesis, Treatment of Empyema. By Professor Eugenio Morelli. Translated by Lincoln Davis and Frederick C. Irving. Boston: W. M. Leonard, 1920.

The author gives a detailed description of the physiology of the mechanics of the chest, careful description of the symptoms of lung and pleural injuries and then a minute and careful explanation of the technique of treatment. This is followed by 65 case histories with X-ray pictures and discussion.

Morelli has certainly presented this class of injuries in a new light, and from his unusual results, one is persuaded that his methods are sound, even more, that his methods have no peer, at least at the present time. J. A. W.

TO those who read Italian this monograph[2] presents a mass of facts and authorities which make it practically unnecessary to search current literature for details concerning hernia.

The author divides his subject into eight sections devoted respectively to the history of the radical cure for hernia, operative procedures, indications for operation, the operative procedure in adolescence and late infancy, the operative cure in early infancy, personal clinical observations, general considerations and a résumé of the important facts concerned in the pathogenesis, pathological anatomy, symptomatology, and operative cure

The monograph is of chief value probably in that it contains a rather unusual amount of statistical data ready to hand, and in that it furnishes a rather comprehensive view of the subject, owing to the orderly, logical, and detailed fashion in which the author develops the various chapters, topic by topic.

All readers, other than those unusually well versed in Italian will lament the absence of illustrations. The very feel of the wonderfully heavy glazed pages is a constant reminder of what pencil and brush might have added. M. G. S.

[2] L'ernia Inguinale Nell' Infanzia. By Prof. Gerolamo Gatti. Bologna and Trieste: L. Capelli, Editore, 1920.

CORRESPONDENCE

MANAGEMENT OF CERVICAL STUMP AND ROUND LIGAMENTS

To the Editor: In your issue of December, 1920, there appeared an article written by me entitled "Management of the Cervical Stump and the Round Ligaments, etc.," in which there are two illustrations of a sagittal section of the female pelvis. These illustrations were taken from casts which were made at Bellevue Hospital, New York, from a dissected, not frozen, body, by a Belgian artisan, under the direction of H. D. Senior, professor of anatomy, and Dr. S. Brock. The illustrations as they appear are the result of the work of an artist P. L. Bissell, done on the photographs of these casts.

At the time the illustrations were published, I was not aware of the fact that any other than an expert artisan at the Bellevue Hospital was concerned in the making of these casts, and was under the impression that he made them to sell to students of medicine. Soon after the December number of SURGERY, GYNECOLOGY AND OBSTETRICS was issued, I received a letter from Dr. William E. Studdiford telling me of the origin of these casts, and I am writing this, in order to give credit to Dr. William E. Studdiford at whose suggestion the casts were made, and to Prof. H. D. Senior, and Dr. S. Brock, who dissected the subject and supervised the modelling of the cast.

DOUGAL BISSELL, M.D., F.A.C.S.

NEW YORK.

BILATERAL RENAL DYSTOPIA

To the Editor: In the January, 1921, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, I read with much interest, an article entitled "Bilateral Renal Dystopia" by Dr. H. W. E. Walther. A statement in it regarding the surgical replacement of the dystopic kidney demands of me a reply. The statement to which I refer is that "Transplantation of the dystopic kidneys has been attempted from time to time, but with little success etc." The author cites one authority only, *i.e.* Munroe, *Boston Medical and Surgical Journal*, 1910, clxii, who refers to a number of cases in which the kidney was transplanted, but where nephrectomy was required later on. It is to be inferred that Dr. Walther is of the opinion that the attempts to transplant the dystopic kidney have never succeeded.

May I call the attention of your readers to the fact that the dystopic kidney has been successfully transplanted in three individual cases. In one of these cases the kidneys were fused and occupied the greater portion of the true pelvis. This case was presented in an article read before the American Gynecology Society, in 1911, entitled "The Pelvic Kidney," and published in the *American Journal of Obstetrics and Diseases of Women and Children*, October, 1911. Permit me briefly to sketch some of the salient features of the case. The fused organ formed a very large mass, situated in the right pelvic region, and occupying the greater portion of the true pelvis. It extended beyond the middle line and reached from the base of the broad ligament to the abdominal wall, appearing there as a large tumor of the lower abdomen.

To transplant this great mass, which not only prevented the uterus from assuming its anterior position, but obstructed almost completely the pelvic passage, it was necessary to sacrifice the artery and vein which terminated at the lower hilum. The severing of these vessels permitted me to lift the fused mass out of the true pelvis, and shift it to the region of the false pelvis where I successfully anchored it according to a technique first published July, 1910, in SURGERY, GYNECOLOGY AND OBSTETRICS. This patient married about 6 months later, became pregnant twice, and was delivered normally. I have had several X-rays taken since her confinement and they have shown the fused kidney to be in position anchored. Had pregnancy occurred previous to operation, development of the uterus would have been impossible, as the body of the uterus was held in a retroposed position by the fused organs. Had it been possible to have forced the body of the uterus forward, and had pregnancy then occurred, the passage of a child through the canal would have been impossible. Another feature of this case of particular interest is the fact that though the two main vessels leading to the lower, or what should have been the left kidney, were severed, and all direct arterial supply to it cut off, and that this lower segment or left kidney was not functioning at the time the patient left the hospital several weeks after the operation, this segment did eventually function normally, recovering its entire blood supply through renal anastomosis from the upper fused segment.

DOUGAL BISSELL, M.D., F.A.C.S.

NEW YORK.

AMERICAN COLLEGE OF SURGEONS

STATE AND PROVINCIAL CLINICAL SECTIONS

During the month of January, the first annual meetings of the Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, North Carolina, and South Carolina Clinical Sections of the Clinical Congress of American College of Surgeons were held. In addition to the general plan heretofore followed a conference on hospital standardization was called to meet on one day of the session. To this conference hospital superintendents, trustees of the hospitals, and nurses were invited. Papers were read giving the points of view of the surgeon, the hospital superintendent, and others interested in the hospital, on the standardization program which has been outlined by the College. This was followed by a general discussion in order to make clear the practical application of the minimum standard. This new feature proved a decided success.

The programs for the different sections follow.

TEXAS

Texas held its first clinical meeting January 7 and 8, with headquarters at the Adolphus Hotel, Dallas. Operative clinics and clinical demonstrations were given each forenoon at the Baptist Memorial Sanitarium, St. Paul Sanitarium, and Parkland Hospital.

Hospital Conference

Hospital Program of the American College of Surgeons, Franklin H. Martin, M.D., Secretary-General, American College of Surgeons, Chicago

The Soul of Standardization, Rev. C. B. Moulinier, S. J., President, Catholic Hospital Association, Milwaukee, Wisconsin

The Work of the Hospital Surveyor, James L. Smith, M.D., Hospital Survey Department, American College of Surgeons

Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint. Arthur Carroll Scott, M.D., Senior Surgeon, Temple Sanitarium

Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint. J. B. Franklin, Superintendent, Baptist Memorial Sanitarium, Dallas, Texas

The Meaning to the Layman of the Minimum Standard. Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons

Discussion led by W. B. Russ, San Antonio

2:30 P.M., Friday, January 7

Organization for Better Surgery, Franklin H. Martin, M.D., Chicago

Discussion of Cases Presented at Morning Clinics

8:00 P.M., Friday, January 7—Public Meeting

Address of Welcome, Palmer Brooks, LL.D., President, Baylor University, Waco

The American College of Surgeons, Franklin H. Martin, M.D., Chicago

The Control of Cancer, Thomas Stephen Cullen, M.D., Professor of Gynecology, Johns Hopkins University, Baltimore

Better Hospitals, Rev. C. B. Moulinier, S. J., Milwaukee, Wisconsin

The Standardization of Hospitals, Judge Harold M. Stephens, Chicago

2:30 P.M., Saturday, January 8

Treatment of Cancer, Thomas Stephen Cullen, M.D., Baltimore

Discussion of Cases Presented at Morning Clinics

LOUISIANA AND MISSISSIPPI

The Louisiana and Mississippi State Sections met jointly, January 10 and 11, with headquarters at the Grunewald Hotel, New Orleans. During the forenoon of each morning clinics were given at the Charity Hospital, Touro Infirmary, Presbyterian Hospital, Hôtel Dieu, and Eye, Ear, Nose, and Throat Hospital.

At the Hospital Conference in addition to the addresses by Dr. Martin, the Rev. Moulinier, Dr. Smith, and Judge Stephens, Dr. S. M. D. Clark, of New Orleans, read a paper on "Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint," and Dr. Tipping, Superintendent of the Touro Infirmary, on "Experience with Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint."

8:00 P.M., Monday, January 10—Public Meeting

Address of Welcome, John M. Parker, Governor of Louisiana

The American College of Surgeons, Franklin H. Martin, M.D., Chicago

Better Hospitals, Rev. C. B. Moulinier, S. J., Milwaukee, Wisconsin

Cancer, and What the Public Can Do for It. Thomas Stephen Cullen, Professor of Gynecology, Johns Hopkins University, Baltimore
The Standardization of Hospitals. Judge Harold M. Stephens, Chicago

2:30 P.M., TUESDAY, JANUARY 11

Résumé of Monday and Tuesday Clinics
Organization for Better Surgery. Franklin H. Martin, M.D.
Weak Spot in American Surgery, Thomas Stephen Cullen, M.D.

ALABAMA, FLORIDA, AND GEORGIA

On January 14 and 15, Alabama, Florida, and Georgia met jointly at Atlanta, Georgia, with headquarters at the Piedmont Hotel. During the mornings from 9 a. m. to 1 p. m., clinics were held at the Grady Hospital, St. Joseph's Infirmary, Georgia Baptist Hospital, Wesley Memorial Hospital, The Gray Clinic, Piedmont Sanatorium, Noble's Infirmary, and the Davis-Fischer Sanatorium.

At the Hospital Conference at the Piedmont Hotel on January 14, in addition to addresses given by Dr. Martin, the Rev. Moulinier, Dr. Smith and Judge Stephens, Dr. R. M. Harbin, of Rome, Georgia, spoke on "Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint."

2:30 P.M., FRIDAY, JANUARY 14

Organization for Better Surgery, Franklin H. Martin, M.D., Chicago
The Differential Diagnosis of Acute Infections of the Kidneys, James N. Baker, M.D., Montgomery, Alabama
Gastric and Duodenal Ulcers, C. C. Harrold, M.D., Macon, Georgia
Infections from Appendix, Cunningham Wilson, M.D., Birmingham, Alabama

8:00 P.M., FRIDAY, JANUARY 14—PUBLIC MEETING

Invocation, Dr. H. W. Cox, President, Emory University
Address of Welcome, Hon. James L. Key, Mayor of Atlanta
Address of Welcome, Hon. T. W. Hardwick, Governor-Elect of Georgia
The American College of Surgeons, Franklin H. Martin, M.D.
Better Hospitals, Rev. C. B. Moulinier, S.J., Milwaukee, Wisconsin
Economic Value to Community of Prenatal Work, John Osborn Polak, M.D., Professor of Gynecology and Obstetrics, Long Island College Hospital, Brooklyn
Standardization of Hospital, Judge Harold M. Stephens
Cancer, Joseph C. Bloodgood, M.D., Associate Professor of Clinical Surgery, Johns Hopkins Hospital, Baltimore

2:30 P.M., SATURDAY, JANUARY 15

What May Be Expected by Newer Methods of Cæsarean Section, John Osborn Polak, M.D., Brooklyn
The Recognition of Breast Lesions at Exploratory Incision, Joseph C. Bloodgood, M.D., Baltimore
Tribute to Dr. Crawford W. Long, Frank K. Boland, M.D., Atlanta
Inhalation Anæsthesia, George R. White, M.D., Savannah
Local and Regional Anæsthesia, H. P. Cole, M.D., Mobile
Spinal Anæsthesia, John F. Denton, M.D., Atlanta
Anoci-Association, L. Sage Hardin, M.D., Atlanta

SOUTH CAROLINA

The South Carolina State Clinical Section met in Charleston, January 17 and 18, with headquarters at the New Charleston Hotel. Clinics were held each morning at the Roper Hospital, St. Francis Xavier Infirmary, and Baker Sanitarium. On January 17, 1921, at 9 a. m. the hospital conference met in the Banquet Room of the New Charleston Hotel. Papers were read by the Rev. C. B. Moulinier, S. J., Dr. James L. Smith, Judge Harold M. Stephens, in addition to addresses on "Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint," by Robert S. Cathcart, M.D., Charleston, and "Experience with the Standardization Program of the College, from the Hospital Superintendent's Standpoint," by Kenneth M. Lynch, Board of Commissioners, Roper Hospital.

2:30 P.M., MONDAY, JANUARY 17

What May Be Expected from the New Methods of Cæsarean Section, by John Osborn Polak, M.D., Brooklyn
The Importance of Certain Mastoid and Lateral Sinus Infections Often Mistaken for Commoner Atypical General Infections, J. Wilkinson Jervey, Greenville
Discussion of Clinics

8:00 P.M., MONDAY, JANUARY 17—PUBLIC MEETING

Address of Welcome, Hon. John P. Grace, Mayor of Charleston
Better Hospitals, Rev. C. B. Moulinier, S.J., Milwaukee, Wisconsin
Economic Value to Community of Prenatal Work, John Osborn Polak, M.D., Brooklyn
The Standardization of Hospitals, Judge Harold M. Stephens, Chicago
How People of South Carolina Can Co-operate with the American College of Surgeons, John G. Clark, M.D., Professor of Gynecology, University of Pennsylvania Medical School, Philadelphia
The Menace of Cancer, Joseph C. Bloodgood, M.D., Baltimore

2:30 P.M., TUESDAY, JANUARY 18

Chronic Endocervicitis, A. E. Baker, M.D., Clinical Professor of Abdominal Surgery and Gynecology, Medical College, State of South Carolina, Charleston
Surgical Kidney, E. C. Baynard, M.D., Professor of Urology. Medical College, State of South Carolina, Charleston
Discussion of Clinics

NORTH CAROLINA

The North Carolina State Clinical Section met in Charlotte, January 20 and 21, with headquarters at the Hotel Selwyn. During the forenoon of each day clinics were held at the various hospitals.

2:30 P.M., THURSDAY, JANUARY 20

Removal of Ureteral Stones by Cystoscopic Manipulation, A. J. Corwell, M.D., Charlotte
Pelvic Inflammatory Diseases, N. D. Bitting, M.D., Durham
The Acute Pelvis, E. T. Dickinson, M.D., Wilson
Urinary Findings in the Acute Abdomen, H. F. Long, M.D., Statesville
Pancreatitis, John B. Deaver, M.D., Philadelphia
Discussion of Clinics and Papers

8:00 P.M., THURSDAY, JANUARY 20—PUBLIC MEETING

Invocation, Rev. A. A. McGeachy, Pastor Second Presbyterian Church
Report of Committee on Arrangements. Andrew J. Crowell, M.D.
Address of Welcome and Introduction of Hon. Cameron Morrison, Governor of North Carolina, John P. Munroe, M.D.
Menace of Cancer, John G. Clark, M.D., Philadelphia
The Relation of the Public to the Medical Profession, W. S. Rankin, M.D., President, American Public Health Association, Raleigh
Economic Value to the Community of Prenatal Work, John Osborn Polak, M.D., Brooklyn
Better Hospitals, Rev. C. B. Moulinier, S.J., Milwaukee, Wisconsin.
The Mission of the American College of Surgeons, J. M. T. Finney, M.D., Chief Surgeon, Johns Hopkins Hospital, Baltimore
Health, the Community's Responsibility, John B. Deaver, M.D., Philadelphia
The Standardization of Hospitals, Judge Harold M. Stephens
Address, Governor Morrison

2:30 P.M. FRIDAY, JANUARY 21

Actinomycosis of Cæcum with Report of Two Cases, F. Webb Griffith, M.D., Asheville
Intussusception of Ileum in Adults Due to Benign Tumors, M. H. Biggs, M.D., Rutherfordton
Abdominal Cæsarean Section for Eclampsia, B. C. Willis, M.D., and E. S. Boice, M.D.
Symposium—Mastoid Disease
When to Operate on a Mastoid, J. G. Murphy, M.D., Wilmington
Complications Following Mastoiditis, H. H. Briggs, M.D., Asheville
A Statistical Study Bearing upon the Value of the Conserved Ovary in Cases of Hysterectomy, John G. Clark, M.D., Philadelphia
Discussion of Clinics and Papers, H. A. Royster, M.D.

At the Hospital Conference held in the forenoon of January 20, in addition to the addresses by the Rev. C. B. Moulinier, S. J., Dr. Smith, and Judge Stephens, addresses on "Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint" were given by Dr. J. Wesley Long, of Greensboro, and on "Hospital Staff Meetings," by John B. Deaver, M.D., Philadelphia.

MEETINGS SCHEDULED TO BE HELD

Iowa—Des Moines, February 28 and March 1.
Nebraska—Omaha, March 3 and 4.
Kansas—Wichita, March 7 and 8.
Missouri—St. Louis, March 10 and 11.
Tennessee—Nashville, March 21 and 22.
Kentucky—Louisville, March 25 and 26.

Figs. 1 and 2. Cystoscopic findings in the author's case.

The Treatment of Bilharziasis of the Bladder.—Diomede Petillo.

SURGERY, GYNECOLOGY AND OBSTETRICS

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THE TREATMENT OF BILHARZIASIS OF THE BLADDER

REPORT OF A CASE WITH PERMANENT CURE

BY DIOMEDE PETILLO, M.D., NEW YORK
Instructor in the Genito-Urinary Clinic of the New York Post-Graduate Medical School and Hospital, New York

WITHOUT any doubt bilharziasis was hitherto the most tragic and the most disappointing of all the genito-urinary pathological manifestations. This is especially true when one considers the invading tendency of the infection and the frequent dreadful complications which take place in its course. In fact it does not spare any single portion of the genito-urinary tract, so that kidneys, ureters, bladder, urethra, prepuce, glans penis, erectile tissue, prostate, and seminal vescicles, all share more or less in the fell involvement of the bilharzia scourge. Here I transcribe a vivid picture of the last stage of bilharziasis from a recent and complete monograph by F. C. Madden: "The patient is in the last stage of weakness, emaciation, and exhaustion. He often carries his scrotum in his hands and has constant micturition, really an incontinence and dribbling, with pains in the penis and all around the perineum. A very small quantity of urine is voided at a time, which is very offensive, gray-green in color or dark with altered blood, and on standing deposits of phosphate débris, blood corpuscles, pus, and ova are found. A hard mass may be felt in the suprapubic region which is not tender but of stony hardness and extends laterally for some distance. Sometimes an atonic fibrous bladder is found with retention of urine or overflow. One or both kidneys will be found enlarged and tender or in a condition of pyonephrosis; and the much dilated, tortuous, and thickened ureters are easily palpated through the very thin abdominal wall. In other cases, urinary fistulæ may be present, and a hard, distorted, permanent erection is the deciding factor."[1]

An adequate idea of the dreadfulness of the bilharzia is attained from its pandemic character in North Africa, particularly in Egypt. So general is the distribution of the bilharzia there that "in almost all urinary troubles one assumes it is present; and one is only concerned in estimating the degree of infection and its possible influence upon symptoms and prognosis. Moreover, particularly in the country districts, a certain degree of bilharziasis is looked upon as inevitable and, indeed, the early hæmaturia is even considered a sign of manhood, without which the begetting of children is impossible."[2]

Up to June, 1919, the treatment of bilharziasis was simply palliative, and a general skepticism prevailed concerning all the methods which were accumulating without giving any result whatsoever. Among the most popular was neosalvarsan; but after the exhaustive clinical experiments made by Day and

[1] F. C. Madden. The incidence of bilharziasis in Egypt, etc.
[2] Loc. cit. Urol. Rev., 1918, Dec.

Richard it was discarded. Binet and Clayton-Green employed intravenous injections of perchloride of mercury with only some benefit, the authors being unable to report a single case of recovery. Regusis experimented with a serum derived from bilharzia patients, "bilharzia red serum," while Day worked with microcidine by intravenous injections, but no conclusive data have been drawn from these experiments.[1] Madden used extract of male fern but as to a relatively valuable trial treatment nothing is mentioned in his beautiful monograph. Walker in his textbook merely emphasizes that "no method of destroying the Schistosomum is known."[2] This sums up the most important literature concerning the treatment of bilharziasis until June, 1919, when fortunately Christoferson's method was announced. I believe his method must be considered a veritable specific means of curing bilharziasis rapidly and permanently. The history and course of my case follows:

Date, June 4, 1919.

S. S., age 27 years; male; married; laborer; referred by Dr. A. Scaturro, of New York. Family history negative. Three years ago patient was affected with multiple venereal ulcers associated with suppurated inguinal adenitis. Almost contemporaneously he began to suffer from an obstinate hæmaturia which lasted 4 months without interruption, subsiding for a few days, only to reappear again and again at brief intervals. The character of this hæmaturia was always terminal and dribbling. There never were any objective urinary symptoms of importance with the exception of a slight burning sensation in the posterior urethra. Two years after the first appearance of hæmaturia the patient was married, the urinary symptoms having no weight on his determination. Early in the second month of his married life he began to notice a certain impairment of his sexual power that gradually became more apparent until he was compelled to consult his physician for weak erections and very precocious ejaculations.

With these symptoms he came under my observation. The physical examination revealed an apparently healthy young man with no evidence of any anatomical or functional deviations. A Wassermann reaction was made which later on proved to be negative. External genitalia normal. Prostate and seminal vesicles were normal in size but rather indurated and tender to the slightest touch. The prostatovesicular sinus had disappeared. There was no liquid at the meatus after a gentle massage Ordinary stream small and slow. Urine macroscopically clear in the first two glasses, containing, however, a few typical prostatic shreds. The third glass became cloudy at the end of the micturition owing to 4 or 5 drops of blood.

Cysto-urethroscopy. Vesical capacity normal. The sensitiveness of the bladder was only slightly increased. The bladder appeared uniformly and exaggeratedly congested. Here and there groups of tortuous vasa projected clearly on the surface of the mucosa. The main cystoscopic finding consisted in two growths of the massive and sessile type; a larger one, in shape and in size resembling an ordinary strawberry, and a smaller one of the size of a lentil situated a few millimeters below the first one. They were implanted on the right lateral wall just above the corresponding ureteral meatus in a very vascularized territory and offered the eye a peculiar view never encountered in the common neoplastic and inflammatory conditions of the bladder. Disseminated over the entire rough surface of the little tumors one could see many yellowish miliary granules descending around the base and gradually disappearing on the adjacent mucosa. In withdrawing the instrument a small group of ovoidal bodies was visible. These were seen projecting from the right lateral portion of the edge of the sphincter which appeared deeply œdematous (frontispiece). In the remaining sections of the bladder, numerous yellowish granulations were scattered all around. The prostatic urethra showed all the pathological changes of a long-standing, intense, inflammatory process. The thick, injected, greyish mucosa was extremely fragile and liable to bleed very easily. The verumontanum was transformed into a shapeless mass whose characteristic structures (utriculus and ejaculatory ducts) were lost among the prominent flabby granulations. The lateral sulci had lost their usual appearance inasmuch as the physiological sinus structure had been substituted by only a slight lowering of the everywhere overabundant and projecting mucosa. Asked whether he had ever been living in a tropical country, the patient said that during the last Italian military expedition in Africa (1913) he was in Cirenaica and Tripolitania for about 18 months, as a soldier. This circumstance put an end to my hesitations and an abrupt probable diagnosis of bilharziasis was made.

A piece of tissue, taken by means of a forceps from the tumor, and a sterile specimen of urine were sent to the pathological laboratory of the Post Graduate Hospital and a few days later a report signed by Dr. MacNeal, plainly confirming the diagnosis. The tumor proved to be papillomatous in character and among the cellular nests were found many ova. A morphological examination of blood gave: polymorphonuclears, 53 per cent; lymphocytes, 17 per cent; large mononuclears, 24 per cent; eosinophiles, 6 per cent. As one can see the eosinophiles were not so markedly increased as they generally are in the trematode group infections.

[1] Loc. cit.

[2] Walker. Genito-Urinary Surgery. New York: Funk & Co., 1914, 451.

The patient was put on an appropriate diet and urinary antiseptics. A few days later I resorted to the fulguration of the little tumors and of the three bigger nodules on the vesical edge of the sphincter, the latter representing accumulations of calcified ova.

As to treatment the literature up to date is very meager and discouraging and from it I was convinced that it would be useless to try the already mentioned methods. I therefore decided to try some new means of treating the patient, for even with the prospect of being ultimately discarded, it would still be worth while, provided it did not harm the patient. I used hypodermatic injections of carbolic acid and in order to watch the urine and to study the limits of renal endurance I advised the patient to enter the hospital. I started treatment with a subcutaneous dose of 8 centigrams of carbolic acid injected twice a day in the gluteous region. This daily dose of 16 centigrams was administered continuously for 10 consecutive days after which I added 8 centigrams more, reaching a dose of 24 centigrams which was administered for another week. During this period urinalysis and microscopic examinations of the sediment were made several times by the Bendiner & Schlesinger Laboratory, of New York, and the reports have always been positive for bilharzia eggs. I gave the patient a week's rest after which I started a second series of injections giving now a full dose of 24 centigrams of carbolic acid a day from the beginning. During this second period four urinalyses were made all with positive report the only encouraging point being a relative paucity of eggs. A second intermission of 10 days was suggested during which two out of the three urinalyses made gave a negative report. But the illusion was of short duration because later on the eggs began to reappear in the sediment.

It was just in this period of uncertainty that I happened to read the communication by Dr. J. B. Christoferson of the Civil Hospital of Khartoum, published in the June 14, 1919, issue of the London *Lancet*. The author who has been working in a zone particularly affected by the bilharzia claims that antimony tartrate has been used by him with permanent curative result. He employed a fresh solution of the medicament in proportion of ½ grain per 3 to 4 cubic centimeters of physiological salt solution. The injection, made intravenously, is repeated for several consecutive days and every other day afterward. For each injection he increases the original dose by ½ grain until a maximum of 2 or 2½ grains is reached. The total dose for a complete cure oscillated from 20 to 30 grains. The purpose, he says, is twofold: first, to kill the parent worms in the portal venous system; second, to sterilize *in situ* the ova deposited on the different organs. The author affirms that the ova resist the action of antimony longer than the worms, so that when we succeed in sterilizing the ova it means that the worms have been killed. I quote his own words: "We have found, after about 12 grains have been injected in about as many days, that *some* of the ova are shrunken, shrivelled, blackish, and the contents granular, and appear as if they had been oxided, and that these would not hatch out in water however long they were left. As injections proceed, an increasing proportion of ova eliminated are granular and dead. Now when it has been confirmed for 2 or 3 days none of the ova hatch out, then the time has come to suspend the injections, for both objects have been accomplished. From observation in our case I think that this takes place after about 20 grains have been injected, but it may be less and it probably varies in different cases."

The patient having refused to enter the hospital I had to consider the case as an ambulatory one. Realizing the possibility that the administration of antimony might endanger the functional capacity of the liver in a man who was compelled to go around in his daily work, I had to be prudent; so I decided to modify the Christoferson method by injecting only a constant dose of ½ grain of the medicament diluted in 10 cubic centimeters of fresh physiological salt solution. In addition I prescribed a small dose of saline solution (sodium phosphate) to be taken every night at retiring and recommended the patient a purin-free diet.

I began the treatment on October 2, 1919, but owing to the fact that the patient had to leave New York for a week, it was interrupted on the 11th, at which date a cumulative dose of 4½ grains of the medicine had already been injected. At this date examination of centrifugated sediment of urine still showed living ova of bilharzia. October 20 a second series of injections was inaugurated and continued without any interruption until December 30, thus reaching a total dose of 40 grains. I want to note that during the intravenous treatment of antimony, occasional irrigations of the bladder were practiced either with 1:3,000 solution of silver nitrate or with 2 per cent mercurochrome.

Table I gives the record day by day, as the laboratory of Bendiner & Schlesinger sent in the reports:

From the date of the last injection (December 30, 1919) to February 27, a number of urinalyses, made every 3 or 4 days, gave an invariable negative report

TABLE I

Date		Dose of Antimony Tartrate Injected (in grains)	Bilharzia Ova
October	20	4½	+
	22	5½	+
	24	6½	+
	26	7½	+
	29	9	+
November	2	11	+
	5	12½	+
	8	14	+
	12	16	+
	15	17½	+
	19	19½	+
	23	21½	+
	27	23½	+
	*29	24½	+
December	2	26	+
	6	28	+
	10	30	+ very sparse; shrunken, dead?
	15	32½	idem
	20	35	idem
	24	37	idem
	27	38½	idem
	**30	40	idem

* From this date on, the urine had been voided after a previous massage of prostate and seminal vesicles.

** Treatment stopped.

for bilharzia ova. The last one, made in the pathological laboratory of the Post Graduate Hospital, signed by Dr. W. J. MacNeal and dated July 31, 1920, gives a negative report as to bilharzia ova.

A cysto-urethroscopic examination performed on June 23, 1920, showed an almost normal bladder with the exception of a few abnormally vascularized small and limited areas of the mucosa and a rather notable degree of hyperinjection of the trigone plus anœdematous condition of the region of the internal sphincter. The posterior urethra, although a great deal ameliorated in its general appearance, still showed a remarkable degree of œdema and congestion, the verumontanum being very prominent and granulating. The lateral sulci and prostatic fossetta appeared far from being cleared of that thick imbibed mucosa characteristic of all exudative inflammations of long standing. The hæmaturia had disappeared since the beginning of the treatment and the urinary streamwas very much improved. The despondency of the patient was greatly lessened but the sexual disorder for which he was referred to me was still unchanged. Naturally if we remember that the impairments of the sexual sphere may be directly depending on anatomical lesions of the prostatic urethra and particularly of the verumontanum, when they exist, it is obvious that they require special attention from the urologist.

A noteworthy circumstance in this case is the fact the patient's wife remains entirely immune from bilharzia as far as I could ascertain through a careful examination of the genito-urinary tract and urinalysis. This would corroborate the assumption made recently that for the transmission of the infection from one to another subject a third medium is necessary.

HABITUAL OR RECURRENT DISLOCATION OF THE SHOULDER

Forty-Four Shoulders Operated on in Forty-Two Patients

By T. TURNER THOMAS, M.D., F.A.C.S., Philadelphia

THIS condition is common enough and its results sufficiently disabling and difficult of cure to give any promising treatment a hearing by the profession. Many devices have been contrived to prevent the recurrences but operation, thus far, has produced the best results. These results, however, have varied much and the best operation has not yet been decided. A very interesting paper by Ollerenshaw, of London, and an unusually good discussion appeared in the *Journal of Orthopedic Surgery* for May, 1920. The purpose of the paper was to support the Clairmont operation in which a flap of the deltoid muscle is passed from behind forward under the neck of the humerus and its end sutured to the same muscle in front so that it afterward acts as a sling to hold the head in the joint. He operated on three cases in the preceding year by this method and to the time of publication there had been no recurrence in any of them. In a preceding case he did a capsule operation (excision of a portion of the capsule) and he says of that case that the operation "has been followed by a perfectly stable joint, although it is now nearly a year since it was performed and the man has worked as a collier since April, 1919."

In the discussion which followed the reading of the paper, Major Dunn, Birmingham, said that he had seen a good many operations for this condition and that in his experience "excision of a portion of the capsule or plication of it has not infrequently been followed by recurrence." In one case in which this operation had failed, Clairmont's operation gave a good result. He did the latter operation on a case 15 months before with complete return of motion in the joint. The patient was a farm laborer and promised to report any further trouble. He had not been heard from since the operation. Mr. Bristow, London, had an epileptic patient who had dislocated his right shoulder 18 times and his left 16 times and on whom he had done the Clairmont operation on the right shoulder 6 months before. Although the patient had had several fits and had dislocated his left shoulder four times, the right had not since gone out. He had since operated on the left shoulder as well. Bristow thinks the good results are due to the strengthening of the capsule by the "lump of ragged muscle," and further strengthening by the addition of fibrous tissue, not to the specific action of the transplanted flap of muscle. Platt did this operation 5 years before, and there had been no recurrence of the dislocation since, but the patient was a professional acrobat and had been unable to return to the stage. He had lost so much deltoid that his shoulder-joint musculature was incapable of bearing the brunt of the gymnastic maneuvers. Trethowan had plicated the capsule in two cases, in one 12 months before and in the other 15 months before. He had not heard that they had recurred since. He found a general distention of the joint and had difficulty in plicating the capsule so that he doubted if plication in the above cases had been done well enough.

In March, 1909, in the *American Journal of the Medical Sciences*, after a thorough study of dislocations of the shoulder, based upon cadaver work done previously in conjunction with the late G. G. Davis, I presented my reasons for attacking the recurrent dislocations by operation on the capsule through the axilla. Since then three papers have been offered in support of this operation and now a four years' accumulation of operative experience is presented for the same purpose. Henderson, in 1918, reported seven cases on which he did a capsule operation and one on which he did a Young operation. In one case the operation had been done too recently to permit a report on it. One case was a failure after both a capsule and the Young operation (lengthening of the tendons of the pectoralis major and latissimus dorsi).

In one case the recurrences were reduced from 12 or more in a year to 2 in the year and a half preceding the time of reporting it. The remaining five may be called cured. The purpose of my paper is to show that the axillary capsule operation is the most rational and most successful, but that it is also anatomically almost impossible.

Extremes of movement at the shoulder tend to force the humeral head out of its socket but are checked by the tightening of the capsule on the opposite side of the joint. The freest and most dangerous movement is abduction, next to that comes external rotation. When the abducting force is too great for the resistance of the capsule the latter tears and the head escapes from the socket into the axilla forcing the torn capsule margins apart. With each repetition of the dislocation these torn capsule margins are separated and finally they cicatrize together across the gap in this distended or separated condition. We thus have added to the normal length of the axillary portion of the capsule a new or cicatricial piece so that when the arm goes into extreme abduction afterward, the capsule can no longer tighten up and prevent the escape of the head from the socket. There is now no necessity for a tearing of the capsule to permit the head to leave the socket and soon after the reduction of the recurrent dislocation the patient is free of pain because there is no inflammatory reaction. The purpose of the capsule operation is to contract this portion of the capsule to within the normal length and afterward lengthen it to the normal by suitable exercises. I now never concern myself about too much stiffness after operation but am concerned if there is too little. This contraction is usually accomplished by excising a portion of the capsule and sewing or allowing the edges to cicatrize together, or by incising the capsule and overlapping the margins by sutures. In other words, the purpose is to reproduce very closely the conditions existing immediately after the reduction of the original dislocation. With the arm in adduction and internal rotation, as in the Velpeau position, the torn axillary portion of capsule would be relaxed and wrinkled so that when cicatrization developed it would be abnormally contracted and the opposing movements, abduction and external rotation, correspondingly limited. We would then have the usual stiff and painful shoulder which we see is the normal healing result of the essential lesion of a dislocation of the shoulder, a torn capsule. The dislocations recurred because the arm was not kept at the side long enough to permit the proper cicatricial contraction of the torn capsule. This is particularly liable to occur in two classes of people, athletes and epileptics, the former because they will not keep the arm at the side long enough for firm healing, and the latter because they have so little control over the situation. If after an operation when the bandages are removed, usually in 3 or 4 weeks, the arm can be placed in nearly full abduction and external rotation, I would be much concerned about the development of recurrences. I have seen delicate women get rid of severe stiffness almost entirely in a year or two without special attention or effort. A strong man can get rid of the worst degrees of cicatricial stiffness following these operations in a short time.

The real problem in these capsule operations is to expose the affected portion of the capsule which lies directly over the dislocated head. Now the head dislocates into the exilla in the overwhelming majority of cases so that the axillary or antero-inferior portion of the capsule should be contracted in them. In one case of recurrent posterior dislocation I exposed and contracted the posterior portion of the capsule, *i.e.* the portion directly over the prominence of the dislocated head and no recurrence of the dislocation ensued. In another similar case the same operation failed but there were special difficulties associated which I hope to take up in a future paper. In all of my other cases in which the dislocations were anterior, except in an atypical one, I contracted the capsule through an axillary incision. The posterior operation was very easy but the axillary operation is not easy and calls for an intimate knowledge of the anatomy of this region. The axillary operation is now done posterior to the axillary vessels and nerves, while at first it was done anterior to them. From my experience with operations

on the living and experimental work on the cadaver, I am convinced that few of these cases are being operated on because of the anatomical difficulties by whatever route selected.

Let us specify, for example, a few of the difficulties. In the usual anterior dislocation the escaping head tears the capsule underneath the large axillary vessels and nerves and comes close the surface below them, *i.e.* posterior to them. This part of the capsule is normally covered completely by the subscapularis muscle. Immediately in front of this muscle and directly over the capsule we find externally the coracobrachialis and short head of the biceps and internal to them the large axillary vessels and nerves. Now the whole area of capsule involved and possible of exposure, if none of these structures obstructed, is only about 2 inches square. There are three possible routes by which it could be exposed in part and in every one of them the exposure is very limited; the deltopectoral or that external to the short head of the biceps; the anterior axillary or that between the coracobrachialis and the axillary vessels; and the posterior axillary or that posterior to the axillary vessels.

My objection to the deltopectoral exposure is that it is too far out. The humerus must be in extreme external rotation to get any exposure of the capsule and even then it will be very limited and will not be at the site of the original laceration. I employed this route for the excision of the humeral head through the anatomical neck in two shoulders and again for a capsule operation in an atypical anterior dislocation. The exposure was very difficult and limited until in the last of the three I divided the tendons of the coracobrachialis and short head of the biceps at their origins from the coracoid process and even then it was still very limited. The subscapularis tendon must be divided. I once had the opportunity of watching a prominent surgeon expose the capsule by this route and became convinced that to him the exposure was difficult and limited. I have had two cases in which this incision had been employed, in one case by a surgeon whom I knew to be a good one and in the other by a surgeon whom I believed to be a good one. It is a fair inference that a satisfactory exposure was not obtained in either case because the dislocations recurred afterward as if no operation had been done. Later I did the axillary operation on both cases and there have been no recurrences since these operations, that in one case done 11½ years ago and in the other more than 4 years ago, the second patient being an epileptic.

The anterior axillary operation which I did in my first ten cases made the exposure between the coracobrachialis and axillary vessels and divided the subscapularis partly. The approach to the joint had to be made carefully and with due respect for the anatomy, but the exposure was freer than by the deltopectoral route and directly over the site of the capsule lesion. I continued to use this route until I realized that during the dislocations the humeral head came close to the surface behind the axillary vessels when I decided to make the incision in this situation. All of my operations on the usual anterior dislocations since then have been by this posterior route. I am not now especially recommending it but am particularly trying to show why this condition is operated on infrequently—because the affected portion of the capsule is almost inaccessible by any route. The posterior axillary route gives me the freest capsule exposure just where the variations in the joint lesion are best detected, divides no muscles, usually requires no ligatures for divided vessels, and gives perfectly dependent drainage which is necessary during the first 24 or 48 hours for an uncontrollable oozing which practically always occurs. The circumflex nerve, however, must be guarded carefully as it lies directly in the field of exposure. I once cut it but had every opportunity for careful and accurate suturing of it. The patient was not told of the accident. After the usual stiffness and weakness following the operation had time to disappear, the patient never complained of any signs of paralysis although he was a hard working man and did much heavy lifting. This accident was directly the result of changing my technique in my efforts to simplify the operation. The young surgeon can not afford to

forget that the operation is distinctly an anatomical one, and he should make his own selection as to the method by which he will approach the capsule according to his confidence in his knowledge of the anatomy of this region. I have never regretted doing the operation and am quick to recommend it to a patient suffering from this condition. It usually takes about a half hour for its performance according to the condition of the joint found. I have no fear of infection. The patient usually gets out of bed 2 days after operation and frequently in one. He practically always leaves the hospital within a week with his arm in bandages as after the reduction of the first dislocation and he is in about the same condition. Good surgical technique and a thorough knowledge of anatomy make it one of the safest and most effective operations in surgery.

The effectiveness of the operation depends, of course, upon the completeness with which the cause of the recurrences is removed, and this will depend largely upon the degree to which the causal condition can be exposed. In the original luxation, the capsule tears along the glenoid margin or its humeral attachment, or somewhere between and more or less parallel to them, and is the result of hyperabduction. The new cicatricial addition to the capsule already described may be of the normal thickness, it may be thicker than normal or it may be of only synovial membrane thinness. It will not always be possible to detect such thin areas with the limited operative exposure so that a very thin and weak portion may be left and a portion of substantial thickness be excised instead. This may account for some recurrences after operation. In one case the hyperabducting force instead of tearing the capsule from the glenoid margin tore away the anterior half of the glenoid process and in the recurring dislocations the humeral head pushed its way between the two glenoid fragments. No operation on the capsule would suffice in this case. The fractured surfaces of the fragments were thoroughly curetted and afterward held apposed in their normal relations to allow firm bony or fibrous union. There were no more recurrences of the dislocations. In another case the anterior half of the glenoid cup had been worn away by the repeated recurrences so that not enough cup was left to hold the head properly. The capsule operation as was expected, proved insufficient and a second operation was done in which the posterior half of the socket was chiselled away until the anterior half was slightly raised. No recurrences followed this operation which was done more than 11 years ago, although the patient was an epileptic. Not infrequently as in this and the preceding case the condition found at operation will call for some special deviation from the ordinary procedure so that the best possible exposure of the capsule and joint is desirable.

In my opinion we shall never understand the pathology of this and other common traumatic conditions of the shoulder region until we appreciate the part played by the fall on the hand and its hyperabducting influence at the shoulder. A dislocation is a fracture of the skeleton at a joint with displacement of the fragments on each other by the fracturing force and a recurrent dislocation is merely an ununited fracture, *i.e.*, a fracture with abnormal movements of the fragments on each other in the direction of the original fracturing force. The ligaments at a joint are to the skeleton what the bone is between the joints. In a recurrent dislocation of the shoulder the axillary portion of the capsule torn by the protruding fragment, the humeral head, in the first dislocation, never had a chance for close firm union afterward because the lower fragment, the humerus, continued to protrude in the direction of the original fracturing force on slight provocation. The fracturing force in the common anterior dislocation is hyperabduction, external rotation also perhaps playing a part; therefore any slight force in these directions, as putting the arm into the sleeve of a coat, easily causes a recurrence of the dislocation. According to its frequency and violence, the anterior margin of the glenoid cup and posterior surface of the humeral head where they come into violent contact in each dislocation, one or other or both, wear away and lessen the resistance of the joint to dislocation. Exact plastic work on the affected portion of the capsule is rendered difficult by the obstacles to its free exposure.

Sometimes the tearing capsule pulls away a piece of the anterior margin decreasing the retaining capacity of the cup. Sometimes the anterior surface of the glenoid process and adjacent surface of the scapula are denuded of periosteum and there is a considerable pouch or pocket between the bone and overlying subscapularis muscle freely communicating with the joint. The task here is to reattach the capsule to the bare bony margin of the glenoid cavity from which it was originally torn. In such a case Perthes nailed the capsule to this bony margin after an extensive incision. Hildebrand packed the wound with gauze to favor adhesions and cicatricial tissue formation, a procedure I have followed in such cases.

RESULTS OF OPERATIONS

In Surgery, Gynecology and Obstetrics for January, 1914, I reported in considerable detail the results of operation on 18 shoulders in 16 patients. I now have 26 more cases to offer which will require too much space for such a method of presentation. What we need perhaps more than anything else is to study our failures.

Of the 44 shoulders operated on, in 2 the dislocations were posterior and in 42 anterior. In the first posterior dislocation operated on the capsule operation has been successful more than a year afterward, in the second the same operation proved a failure with the first convulsion following operation, both cases being in epileptics. In the failure the joint condition found at operation proved difficult to combat, especially with so little time to deliberate, and I could not then think of a satisfactory solution to the difficulty. The posterior recurrent dislocations are so infrequent, my experience is so recent, and the problem presented so new, that the subject should receive separate consideration.

ANTERIOR DISLOCATIONS

Of the 42 anterior dislocations operated on 24 occurred in nonepileptics and 18 in epileptics.

Nonepileptics. In 18 of the 24 there has been no dislocation since operation, the three most recent cases being operated on three months or more ago and the first nearly thirteen years ago. Two of them died, one 16 months after operation and the other 6 years after operation. Several have been vigorous athletes after operation; others have been coal miner, laborer, farmer, river bargeman, prize fighter, etc.

It may be of interest to note again to what degree I have gone in my efforts to determine the strength of shoulders operated on. In all of the nonepileptic cases only the capsule operation was done, in three shoulders in epileptics bone operations were added. There were four shoulders in nonepileptics in which one or more dislocations followed operation but in which distinct cures have since been obtained without further operation. One of them may not yet deserve to be put in that class but I am inclined to place it there. This young man was operated on August 30, 1918. In a basket ball game about May 1, 1919, in an attempt to knock down a flying "medicine ball," weighing about 12 pounds, with the hand of the side operated on, he again dislocated that shoulder. After 2 weeks' immobilization in the Velpeau position and avoidance of elevation of that arm as far as possible for 3 or 4 months, he gradually developed normal motion and muscle strength and has had no more dislocations. The following will explain why I believe this patient has as good prospects as any of the next three cases had in the corresponding stage:

Pain and stiffness usually follow the reduction of the first dislocation because of the inflammatory reaction in the injured tissues, especially the torn capsule. After the development of easy recurrences these symptoms do not follow after each reduction because the capsule after the first tear healed long enough to permit the dislocation to occur on slight violence without a new tear so that no inflammatory reaction follows. But after an operation on the capsule some cicatricial contraction of it must result so that another dislocation can not occur without some capsule laceration. Immobilization of the arm at the side after the reduction of the dislocation must be followed by new cicatricial contraction of this again torn axillary portion of

Fig. 1. Patient on whom high excision was done in both shoulders; in right shoulder 4 years ago, and in left shoulder 16 months ago. Operation scar visible. Note absence of atrophy and flail shoulder on both sides and active elevation of both arms.

the capsule, so that if the patient is willing to follow instructions he can add to the strength of the weak portion of the capsule with each recurrence until no more follow. This pathology is supported by the next three cases in nonepileptics. For fuller details of these cases the reader is referred to the above paper in SURGERY, GYNECOLOGY AND OBSTETRICS for January, 1914.

An athletic medical student, operated on November 23, 1909, within the first year afterward, from violent wrenchings of the same shoulder, on two occasions, had the sensations of momentary dislocations. Under date of March 3, 1920, he writes that the shoulder is as strong as it ever was, that he has had no dislocations since the operation, although it has been exposed to violence many times including being thrown from a horse while in the service in France. He may have forgotten the sensations of momentary dislocations of 10 years ago.

An athletic law student was operated on December 20, 1909, and a considerable defect found in the subscapularis muscle where the humeral head had been thrust through it in the first dislocation. He afterward engaged in violent athletic work including heavy weight wrestling and in a wrestling contest dislocated the same shoulder on November 25, 1912. He afterward went back to his gymnasium work. On January 24, 1917, in a boxing contest his opponent gave this shoulder a violent wrench and redislocated it. After the usual prolonged immobilization of the arm at the side, he purposely preserved a moderate degree of limited abduction and since then has done all kinds of athletic work, worked in a lumber camp, swam far from shore, done much boxing and saw much active service as an artillery officer in France, but has had no further dislocations. I see this patient from time to time.

Another strong young man, operated on September, 24, 1913, had a redislocation 7 months afterward when a horse fell on him throwing him to the ground. Under date of February 19, 1920, he wrote that he is capable of doing any kind of hard work and has had but the one dislocation since operation. Word has been received, directly or indirectly from everyone of my living patients within the past eight months, and in each instance it has been requested information be sent promptly of any trouble developing in the meantime.

Failures. A young man who was slender and never enjoyed good health was operated on January 5, 1913. On January 17, 1914, he had another dislocation from slight violence and a second dislocation on October 14, 1914. On October 29, 1914, a second capsule operation was done on this shoulder and on January 3, 1916, the same shoulder was redislocated from slight violence. I detected nothing in either operation which would account for the failures. This is the only nonepileptic case which was operated on the second time.

A strong young man, operated on May 25, 1918, left the city for his home in a distant state in about 2 months and never returned. On August 5, 1919, while repairing an automobile in reaching for a difficult position he wrenched and dislocated the same shoulder. He did not immobilize the arm and soon had another dislocation and after this more of them.

Epileptics. Of the 18 shoulders in epileptics the capsule operation was done in 17, in one only a high excision (Figs. 1 and 2). In 11 of the capsule cases and in the high excision, there have been no dislocations since the operation in each.

a. *b.*

Fig. 2. Showing how much of humeral heads remained after the high excisions. The lower heavy straight lines mark usual level at which head is excised for this condition because that much of head is thought to leave joint in a dislocation. Upper heavy lines mark level of anatomical neck. The results in this case prove that the high excision removed enough of the heads to stop the dislocation. There has probably been some growth of bone from the cut end of the humerus since the operation. *a*, Right shoulder; *b*, left shoulder.

In the six remaining cases dislocations followed the first capsule operation. In one of the early cases dislocations followed the second capsule operation after which the patient was lost track of. In another case they followed three capsule operations when a high excision was done (October 28, 1916), after which there were no more dislocations. The first capsule operation in one case showed a very defective glenoid cavity which was reshaped in a second operation, 9 years ago, after which there were no more dislocations and the function of the joint became almost normal. In a fourth case after a capsule operation, prolonged immobilization in the Velpeau position in a plaster cast was tried with the object of forming firm cicatricial union. When the cast was removed it was found that the head had been out of the socket probably for some time. During a second capsule operation it was found that with the arm at the side, the humeral head would drop out of the socket into the usual dislocated position. Permission for an excision had not been obtained and the capsule operation had to be relied on again, the head being kept in the glenoid cavity by maintaining the extreme Velpeau position. This position was held by a cast for 3 months. The cast has been off for 6 months and the patient has had repeated convulsions but no more dislocations, thus far. In a fifth case a second capsule operation was done October 11, 1919, and proved a failure. Upon the reduction of the first dislocation following this second operation, the arm was fixed in a plaster cast in the Velpeau position with the same purpose as in the four nonepileptic cases already mentioned as cured without a second operation. This cast was not removed for 3 months, and 3 months have passed since it was removed. Although the patient has had numerous convulsions since then he has had no further dislocations.[1]

The high excision performed in both shoulders of the same patient (Figures 1 and 2) deserves special mention. In my first epileptic case the dislocations recurred after two capsule operations probably because of the powerful convulsions and a large defect in the humeral head, and I then concluded that only an excision or an arthrodesis would stop the recurrences. I had in mind the ordinary

[1] This shoulder was again dislocated about December 1, 1920. An interne and myself on different days, each succeeded in reducing the dislocation, but neither could maintain the reduction when the reducing force was removed. The normal retentive capacity of the joint had, evidently, been lost by excessive bony defects at the usual sites. The high excision (Fig. 2) was performed December 13, 1920.

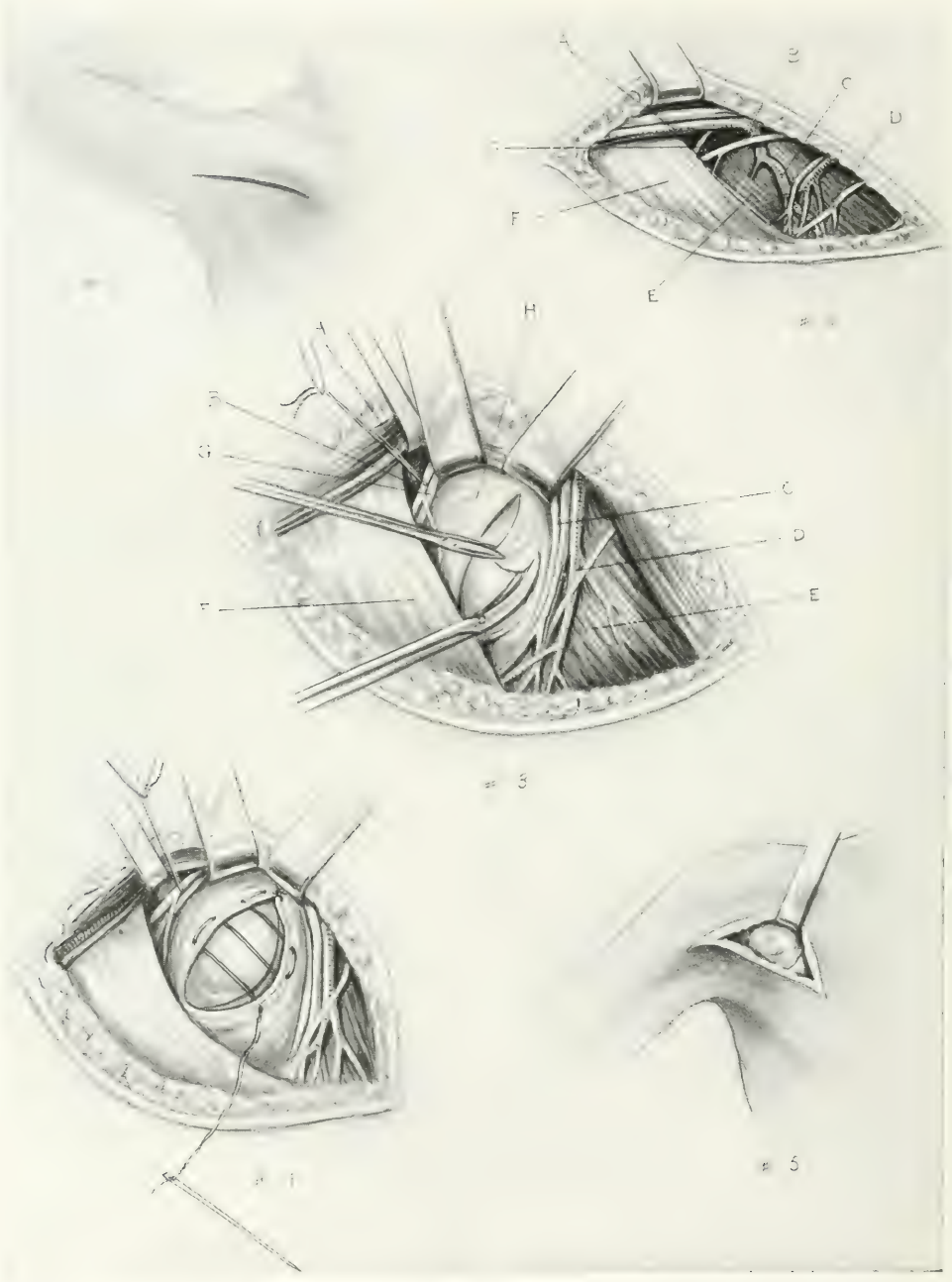

Fig. 3. Showing the essential features of the capsule operation done through an incision posterior to the axillary vessels and nerves. It will be necessary only to locate, expose, and especially guard the circumflex nerve. *a*, Axillary artery and vein; *b*, circumflex nerve; *c*, subscapular artery; *d*, subscapular nerve to the latissimus dorsi muscle; *e*, subscapularis muscle; *f*, latissimus dorsi muscle; *g*, posterior circumflex artery; *h*, capsule.

excision through the surgical neck of the humerus which removes the attachments of the very important rotator muscles and almost always leaves a flail shoulder-joint, the functional result being very undesirable. The excision in this patient was done through the anatomical neck or still higher but removed all of that part of the head which projects out of the socket in a dislocation so that afterward a dislocation became impossible. The groove which I have always found in the posterior part of the humeral head when I looked for it marks clearly how much of the head projects from the socket because it is made by the pressure of the anterior glenoid margin when the head is in the dislocated position.

The surgeon who attempts for the first time any of the capsule operations must depend for guidance on descriptions of the operation selected, because there are no satisfactory illustrations in the literature, so far as I know. For a description of the anterior axillary operation the reader is referred to a paper in the *American Journal of the Medical Sciences* for March, 1909; for one of the posterior axillary operation to SURGERY, GYNECOLOGY AND OBSTETRICS for January, 1914; and for one of the high excision of the humerus (with illustrations), to the *Annals of Surgery* for October, 1917. Figure 3 will amplify the description of the posterior axillary capsule operation.

Most surgeons have preferred and will probably continue to prefer the deltopectoral capsule operation. I have now done all three capsule operations but much prefer the posterior axillary. Only one surgeon, Telford (*Lancet*, London, August, 3, 1912), showed a preference for the anterior axillary operation. In a personal communication about 4 months ago, Leonard W. Ely, San Francisco, expressed much satisfaction with the posterior axillary operation. He says "It is a beautiful operation and I found it almost bloodless."

SUMMARY OF RESULTS

The wearing away of the bony parts from pressure contact during the dislocations, if nothing else, will prevent a complete return of the joint to the normal. Therefore, the terms success and failure as employed here can have only a relative meaning. It is also impossible to decide upon a time limit for a positive cure.

Of the 24 shoulders in nonepileptics, in all of which only the capsule operation was performed, in 18 there have been no dislocations since the operation, done in the most recent case 3 months ago and in the first nearly 13 years ago. Four more cases, in which only one operation was performed, may fairly be classed as cures, making 22 successful results from the capsule operation. Two cases have been failures, one after two operations and one after one operation.

Of the 18 shoulders in epileptics the capsule operation was done in all but one in which only a high excision was performed without any further dislocation. In 11 cases one capsule operation in each was completely successful after 4 years in the most recent case and 11½ years in the first. Of the remaining 6 cases, 1 was successful from reshaping the glenoid cup after a failure by one capsule operation, and 1 was successful from a high excision after three capsule operations had failed. This operation in my opinion, will stop the dislocations in any case but impairs the joint function considerably. Two recent cases show encouraging results after the second capsule operation. (See above foot note concerning one of these.) Two cases are classed as failures, one after two capsule operations and one after one capsule operation had been performed.

CONCLUSIONS

The pathology of recurrent dislocation of the shoulder concerns the skeleton and the essential problem is to repair the defect in the skeleton. This involves the bony and ligamentous portions of the joint. Usually it will be sufficient to repair the capsule lesion, rarely the bony defect must be attacked. In proof of this the above results are offered. Further study and experience should improve them.

A PERINEAL OPERATION FOR REMOVAL OF STONE IN THE LOWER END OF THE MALE URETER

By OSWALD SWINNEY LOWSLEY, A.B., M.D., F.A.C.S., New York
From the Urological Department of Bellevue Hospital, New York

THE accessibility of the lower end of the ureter by means of the perineal route was impressed upon me particularly while performing a rather difficult seminal vesiculectomy. The tissues were so matted with adhesions that it was deemed advisable to identify the ureters for their safety. This was easily accomplished. The thought immediately occurred to me that a stone lodged in the terminal inch of the ureter could be more easily removed *per perineum* than by abdominal incision.

A review of the anatomy of the male pelvis and careful dissection on the cadaver resulted in the development of the following operation.

TECHNIQUE

The patient is placed in the exaggerated lithotomy position with the hips well elevated. The perineum, scrotum, and penis are prepared in the usual manner.

A horseshoe-shaped incision is made in the perineum, the curve being above the bulbous portion of the urethra and the ends well to each side of the rectum.

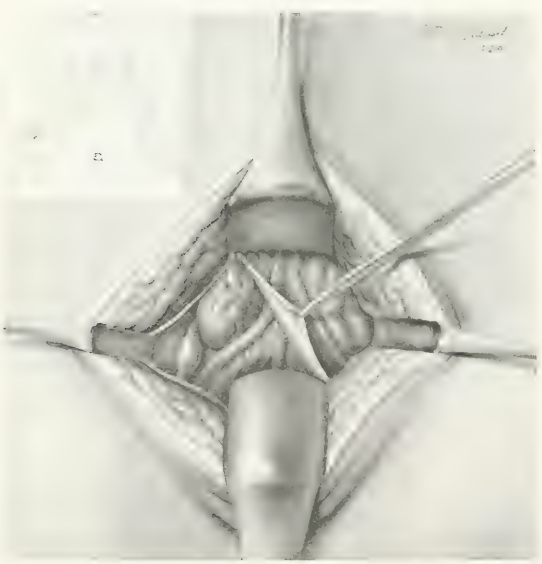

Fig. 1. Exposure of right seminal vesicle with stone in ureter just above its tip.

The incision is then deepened, central tendon severed, and incision carried downward hugging the urethra, until the apex of the prostate is reached.

It is well to have a sound in the urethra to act as a guide.

At the apex of the prostate the recto-urethralis muscle must be incised to avoid tearing into the rectum, which might result if blunt dissection were attempted (Fig. 1). The levator ani muscle is then separated from the prostate exposing the posterior surface of that organ, recognized by the glistening fascia of Denonvilliers which covers it. By continually dissecting upon the genito-urinary organs one avoids the rectum.

A blunt-toothed retractor is then fixed at the base of the prostate gland as shown in Figure 2, the sound having been removed from the urethra. Traction upon this pulls the prostate and seminal vesicles forward. It is well at this point to elevate the foot of the table considerably, as the wound is quite deep and the ureter is on the roof of the wound. The intervesicular fascia[1] is then incised and drawn laterally, exposing the ampulla of the vas and the seminal vesicle of the effected side. The dissection is continued deeper, the rectum being held down by a long curve-backed retractor (shown in Fig. 2). The ureter is found emerging just above the very tip of the seminal vesicle. It is isolated from the surrounding tissues by blunt dissection; the seminal vesicle being freed and lifted up slightly. A tape is then passed around the ureter, beyond the site of the stone if possible. Longitudinal incision is made in the ureter directly over and below the stone, which is removed with bulldog forceps. It is extremely difficult to insert a suture into the ureter;

[1] Anatomy of the human prostate gland and contiguous structures. Surg., Gynec. & Obst., 1915, xx, 188.

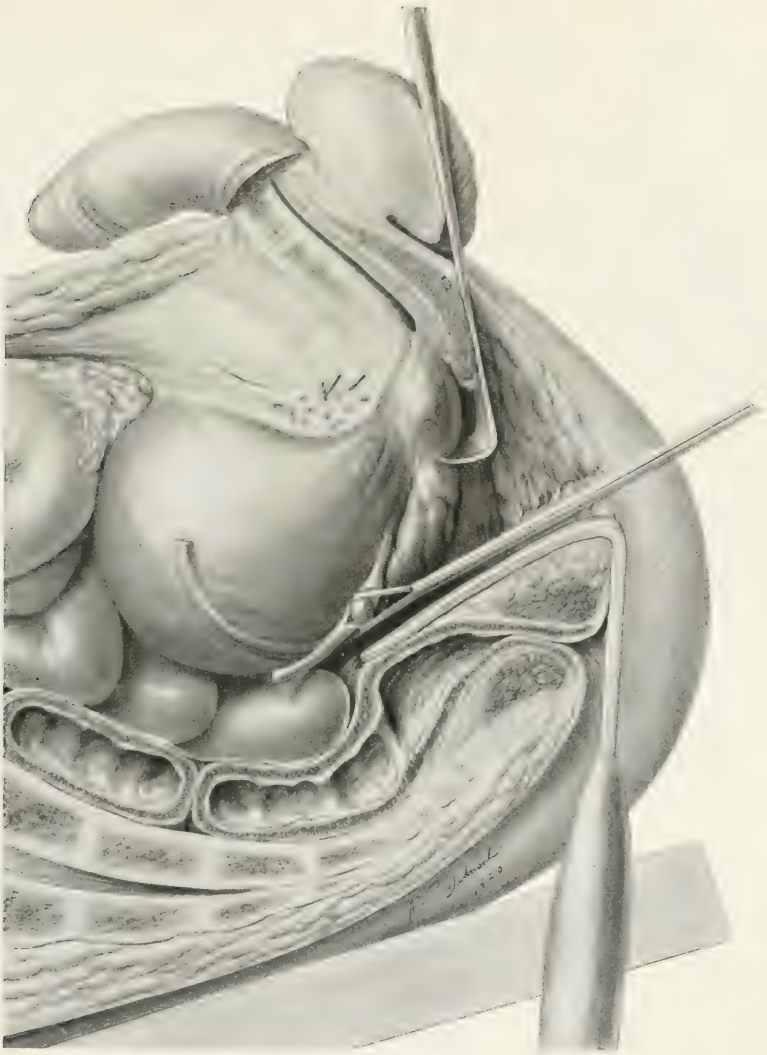

Fig. 2. Sagittal view showing removal of stone and retraction of tissues.

therefore one must be content to insert a cigarette drain to the point of incision.

Closure is accomplished by drawing the separated levator ani fibers together by one or two plain catgut sutures and the skin is closed by silkworm-gut.

Dressings should be changed frequently during the first few days as there will be a considerable leakage of urine through the perineal wound. In order to hasten the healing of the ureteral wound a catheter may be passed into the ureter by means of the cystoscope and left in position for a day or two.

The description of a case in which a ureteral calculus was successfully removed by the perineal route follows.

J. S., age 41, admitted to Ward K4, Bellevue Hospital, suffering from chills, fever, general weakness, and cloudy urine. The family history reveals no tuberculosis, cancer, or chronic diseases. The patient has had the usual children's diseases: measles, mumps, whooping cough. In 1907 he had a nephrotomy (right side). Five years ago he had chills, fever, and sweating which lasted only a short time. One year ago he had considerable pain in left kidney region. For the past year he has had frequent attacks similar to the last one, *i. e.*, chills,

Fig. 3. Right seminal vesicle held to one side and ureter opened over stone.

fever, drenching sweats, with very cloudy urine. He has lost 20 pounds in the past 3 weeks and complains of general weakness. He voids three to four times daily and occasionally once at night. He has no difficulty in urinating. About 7 years ago he passed small stones. He had gonorrhœa 15 years and 5 years ago.

About 12 days ago he had last attack of chills followed by fever, drenching sweats, and prostration. He states that the urine has been very cloudy before attack and becomes clear subsequently. He has experienced no pain with these attacks, but has felt completely "played out" since last attack.

Physical examination. The patient is a male adult, who is up and around, but has an anxious expression and appears ill. He is somewhat anæmic. His eyes react to light and accommodation. Teeth are good. Tongue is clean. Throat is negative. Neck is negative. The chest is symmetrical. There is no enlargement of heart, the sounds are clear but rather distant. There is good resonance throughout, with no evidence of pulmonary disease. The right kidney is palpable on ballottement, no other organs or masses felt. There is a scar of old operation in right loin. There is moderate left varicocele, but penis, testicles, and epididymides are normal. The extremities show no abnormalities. Knee jerks are absent; no Babinski, cremasteric. The abdominal reflexes are normal. The biceps are absent. Rectal examination shows the prostate slightly enlarged with some induration; vesicles palpated, slightly enlarged.

Provisional diagnosis: pyonephrosis, varicocele.

Urinalysis, May 12, 1920. Turbid; straw color; specific gravity 1,004; acid reaction; albumin, 1 per cent; glucose 0; 200–300 pus cells per low power field (not centrifugalized).

X-ray reyorts, May 15, 1920. There are numerous calculi of the left kidney, varying in size from ¼ inch to 1¼ inches in diameter. This kidney is markedly enlarged.

Cystoscopic examination by Dr. Stevens, on May 17, 1920. Posterior wall of bladder poorly seen, apparently chronically inflamed, vessels not visible. Ureteral orifices are in normal position and of normal contour. The catheters pass with no noticeable obstruction to pelvis of both kidneys. Clear amber urine flows from right kidney; very turbid (smaller amount) from left.

Phthalein injected in vein; color appeared from right side in 3½ minutes. Collection made for 10 minutes. X-ray taken with catheters in ureters.

Left lower pole is at the level of the transverse process of the fourth lumbar vertebra. The lower pole of the right kidney is at the same level. There is a calcareous area 3/8 inches in diameter lying above the inner side of the right ischial spine, a corroborative examination of which will be made.

Note by Dr. Lowsley, May 18, 1920: The lower pole of left kidney is felt. The right not felt. There is moderate left varicocele; epididymides and testicles normal. The prostate is of usual size. The right border is masked by adhesions, the left is clear. Both seminal vesicles are enlarged.

May 19, 1920. An opaque catheter directly overlies a calcareous area of the lower right ureter. A calculus of the right kidney is present as previously described.

Cystoscopy by Dr. Lowsley, May 22, 1920. Bladder mucosa is normal in appearance. A wax bulb is passed with difficulty into right ureter to kidney pelvis (some of wax scraped off by cystoscope); catheter passed to left kidney without obstruction. X-ray taken at two angles on same plate. No wax on catheter when it was examined after cystoscopy (right ureter). Left catheter did not work, no urine or phthalein coming through in 30 minutes. Specimens were collected for microscopic and phthalein tests. Bladder catheterized after cystoscopy for left side specimen and leakage around right catheter.

Ureteral specimens:

	Right	Left
Amount	10 cubic centimeters	6 cubic centimeters
Phenolsulphonephthalein	5 per cent	very faint trace
Urea	0.7 per cent	0.1 per cent
Wet specimen	no pus	loaded with pus
Stained specimen	no organisms no tubercle bacilli	no organisms no tubercle bacilli

X-ray examination, May 25, 1920. There is present a large cuneiform calculus in the pelvis of the left kidney. There are numerous small calculi in cysts in the lower pole of the left kidney. There are also some small calculi in an encysted area in the upper pole. The left kidney is hydronephrotic, the right kidney is also markedly enlarged. There is an oval calculus ½ inch in length in the lower part of the right ureter, 1½ inches above the entrance of the bladder.

The patient was operated upon by the method described above with the exception that a long Young's tractor was used to draw the bladder down into the wound.

The drain was removed first day. The patient was up in a chair on third day after operation. There was considerable leakage through fistula in perineal wound. Except for this tract, wound was healing nicely. Stitches were removed sixth day. Eighth day catheter No. 6 F. was passed with difficulty past the incision in ureter and left in position for 4 days. A considerable portion of the urine passed through the catheter and very little through the fistula.

Fig. 4. Closure with drain inserted to point of ureteral incision.

The left kidney was removed by Dr. Lowsley, June 8, 1920; and patient was out of bed tenth day, home cured on twenty-first day, and reported to return clinic July 15 and 22 and was well and had gained 15 pounds. Patient seen on January 28 and found to be in excellent condition. Ureter again dilated.

LITERATURE

Keyes, p. 852, states:

In the female, large stones caught just external to the bladder may be reached by incision in the vaginal vault; but if the stone is at all movable it is fixed in the position with great difficulty and when the incision in the vaginal vault has been made the stone will be found to have slipped out of reach up the ureter. For small stones, therefore, even in the female, the abdominal route is preferable.

Fenwick, *Edinburgh Medical Journal*, 1898, n. s. iii:

I approached the stone through a transverse perineal incision. I had no hesitation in adapting this route for it had become familiar to me in resecting pieces of vesiculæ seminales, etc. . . . With the aid of a narrow, long-tongued retraction I was able to dissect between the rectum and the lower urinary tract, every step of the route being illuminated by a Washington-Isaac search light. I rapidly reached the ureter, being guided to it by feeling the stone in it forced within reach of my finger by the pressure of the dresser's hand upon the abdomen. A clean incision into its long axis released a quantity of clear urine and the stone which weighed 2½ drams. The latter resembled a small peach stone in size and appearance. On inserting the finger into the ureter, it was evident that the calculus had been lying in a dilation of the canal for the caliber was here about

Fig. 5. Roentgenogram, J. S., May 17, 1920, showing stone in right ureter lying beside shadowgraph catheter.

Fig. 6. Roentgenogram, J. S., May 22, 1920. Two exposures on same plate. The X-ray tube was moved 1 inch laterally. This shows calculus moving exactly with catheter. If the shadow were in front or behind ureter there would be a discrepancy.

an inch across. I passed a thick, windowless drain-tube up toward the kidney, and stitched its lower end into the perineal wound, providing thus for an easy route from the ureter into the perineum. . . . . The stone did not obstruct the passage of urine from the kidney because of the deep flutings on the surface.

Henry Morris, *Edinburgh Medical Journal*, 1898, n. s. iii:

When a stone is impacted near the lower end but too far off to be recovered through the bladder or the vagina the sacral route should be employed. In the male the prerectal route is available; thus M. H. Fenwick successfully removed a calculus the size of a small apricot stone from the ureter 2 or 3 inches from the bladder by dissection between rectum, etc.

Extraction of a stone impacted in the vesical part of its course or in a ureteral pouch should be effected *per urethram* in the female, if possible, and by perineal or suprapelvic cystotomy in the male. These two were advocated by me in 1884. The perineal incision is said to have been practiced by Desault and Garengect. Unless the patient is very thin and the pelvis shallow the suprapelvic operation is to be preferred to the perineal. Tuffier has removed a ureteral calculus in this manner.

Hugh Young, *Transactions Southern Surgical Association*, 1902, xvii, 169, states:

The perineal prerectal route has only been employed by Fenwick who made a transverse incision in the perineum, separated the rectum from the prostate and thus exposed the ureter with a calculus impacted in the juxtavesical position. The stone was removed through a longitudinal incision. The ureter was drained. . . . Fenwick thinks this the method of choice where the calculus is low down in the ureter. Regnier tried to reach the ureter this way but had to employ the iliac route. Calculus of the deep pelvic ureter in the male has received much attention and there is still little unity of opinion in the literature as to the proper method of attacking it. . . . I cannot agree with Fenwick and Morris, authorities though they be, in considering it the method of choice in the male, but feel convinced that the iliac route is the only justifiable route.

Ricketts, *St. Louis Medical Review*, vi, "Summary of Method of Reaching Lower Ureter:"

The routes which have been proposed to the present for operation upon the lower ureter are:

1. The intravesical, suprapubic, perineal, and transurethral;
2. Intrarectal or transrectal used by Cesi; patient died;
3. Iliac or para-Poupart incision;
4. Sacral route, Cabot 1892, worked on cadaver;
5. Pararectral route, Morris, incision from a point opposite third sacral spinous process to point 1½ inches below the tip of coccyx;

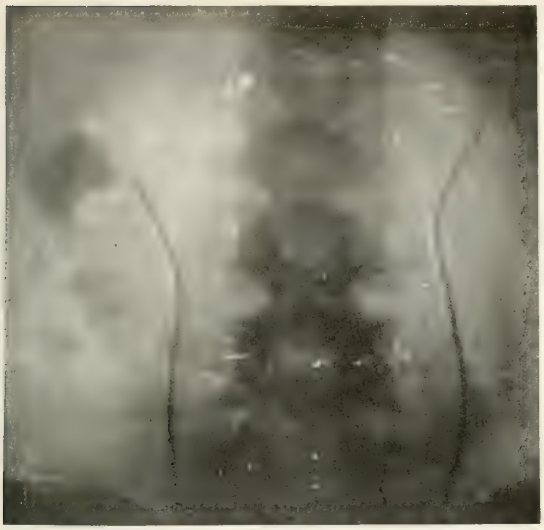

Fig. 7. Roentgenogram, J. S., May 22, 1920, showing stones in left kidney.

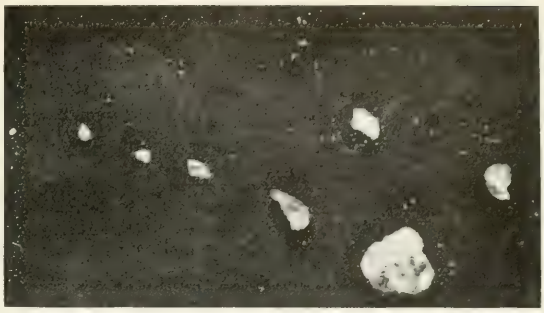

Fig. 8. Stone crushed in removal from right ureter by perineal route—case J. S.

6. Perineal route, Fenwick—used where the stone was felt through rectum;

7. Transperitoneal route, too dangerous to be attempted.

CONCLUSIONS

1. No conclusions can be drawn from a single case. The lesson taught by this particular case seems to be that removal of stone by the perineal route should not be attempted if (a) the stone is more than 4 centimeters from the bladder; and (b) it is not fixed in its position.

2. Stone impacted at the point where the ureter joins the bladder wall is accessible *per perineum* unless the patient is obese.

3. Provided a stone is successfully removed from the ureter by the perineal route the patient may be allowed out of bed after the second day and the downhill drainage would seem to be a decided advantage in that the chances of thick scar formation around the ureter are less.

The advantages of this operation are:

a. This portion of the ureter is more accessible *per perineum* than by any abdominal operation.

b. The patient may be allowed out of bed 2 days after operation.

c. The downhill drainage from the incised ureter prevents absorption of urine and deleterious results from concomitant infection which frequently accompanies urinary lithiasis.

d. Chances of wide infection of tissues around incision in ureter and subsequent stricture of ureter are much less.

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The author wishes to express his gratitude to Dr. E. L. Keyes, Jr., upon whose service at Bellevue Hospital the operation was performed.

TISSUE RESISTANCE IN MALIGNANT DISEASE

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ACCURATELY to define anything is to give in brief form so succinct an account of the object or process that only the details have to be filled in. Moreover such a definition should admit of no exceptions. So far no lexicographer has provided us with a satisfactory definition of malignant disease, for the good reason that we know little of the essential nature of malignancy, and without complete knowledge the perfect definition is impossible.

The sum and substance of all such definitions, however, is that a malignant growth consists of cells possessed of abnormal and apparently unlimited power of multiplication, that these cells may enter the lymph or blood stream, and, when planted in suitable soil, reproduce the original growth from which they sprang. The cells of a malignant tumor may be termed the bolsheviki of the body, for they know no law, pay no regard to the commonweal, serve no useful function, produce disharmony and destruction in their immediate surroundings, and scatter the seeds of future trouble in distant parts. It is to some peculiarities in the behavior of these seeds of trouble that I wish to direct attention in the present paper.

The property of discharging cells into the general circulation is by no means confined to neoplasms. In an organ where the parenchyma cells come into very close relationship with thin-walled blood-vessels these cells may become migratory. Cells of the chorionic villi, the liver, and other parenchymatous organs have been found in the lungs. In that most remarkable condition known as general thyroid malignancy, nodules exhibiting typical and apparently normal thyroid structure are found scattered throughout the skeleton, although there may be no discoverable tumor in the thyroid itself.

It is in malignant tumors, both sarcomata and carcinomata, that the cells show their greatest tendency to become detached into the blood stream. It is but natural that tumors should vary in the degree to which they possess this deadly property. Anyone familiar with the histological picture in epithelioma of the skin and chorio-epithelioma of the uterus will readily understand why propagation through the blood is extremely rare in the former and very common in the latter.

It is a mistake, however, to imagine that the formation of metastases is merely a matter of discharging into the circulation, cells with malignant properties. There is in addition the question of tissue predilection. It is common knowledge that tissues differ in their liability to metastases. As Virchow first pointed out those organs such as the breast, the stomach, or the uterus which are frequently the site of primary growths, are as rarely the seat of metastases, and the reverse also holds true.

Many of the peculiarities of distribution of secondary growths can no doubt be explained

on anatomical grounds, and it is easy to understand why the liver should be so frequently involved in neoplasms of the alimentary tract; the lungs, in those of the uterus. Much that is mysterious in the distribution and behavior of metastases cannot, however, be explained in this simple manner. Tumor cells must be carried in large numbers to the heart, the spleen, and the muscles, yet why should secondary growths in the two former be rare, in the latter almost unknown? It is not sufficient that tumor cells be discharged into the circulation for a metastasis to be formed; of paramount importance is the relation established between the arrested cells and the new environment in which they find themselves.

This truth is well recognized in the case of metastatic abscesses in infectious disease. A vegetation on the heart valves may spray out innumerable streptococci into the blood stream, but most of the seed falls among thorns or by the wayside, and only that which falls on good ground brings forth fruit in the shape of metastatic abscesses. In other tissues the conditions are not favorable to bacterial growth. Recent work has shown the great influence which the reaction of the medium exerts on bacterial growth. In the case of the more delicate bacteria a slight alteration in the reaction may completely inhibit the growth. The highly acid environment which the muscles provide may thus well prove inimical to bacteria struggling to gain a foothold.

The analogy between the metastases of infections and those of malignant disease is an enticing one, but Darwin's warning that analogy is a deceitful guide may well give us pause; for the nature of the metastases is entirely different in the two cases. In the first the bacteria are carried to a new site, and there bring about certain proliferative and destructive changes on the part of the tissues, while in the second it is the newly arrived cells which proliferate, not those of the affected part. In both cases, however, we are confronted with the striking phenomenon of tissue predilection, and it is possible that information gained regarding the one may throw light on the nature of the other.

Fig. 1. Case 1. Considerable involvement of right humerus, September, 1916.

Fig. 2. Case 1. Right humerus almost entirely replaced by carcinomatous tissue. Pathological fracture. Smaller deposits in bones of forearm. October, 1917.

Fig. 3. Case 1. Metastases in left arm. October, 1917.

It is more than probable that there exists a preliminary interval during which it is not possible for secondary growths to be set up, a refractory period in which the tissues are being sensitized and prepared, it may be by the action of ferments produced by the tumor cells—a period, that is to say, of comparative immunity.

The following three cases, for the clinical details of which I am greatly indebted to Dr. J. E. Lehmann, illustrate some points in tissue immunity.

Case 1. Mrs. M., age 40, a stout well-nourished woman, was admitted to hospital in the fall of 1915 complaining of a lump in the breast. A diagnosis of carcinoma was made, the breast was removed and was found to contain a scirrhous cancer. The axillary glands were also involved. The diagnosis was confirmed by microscopic examination. Early next year she returned complaining of pain in the right arm. A roentgenograph was taken and unmistakable evidence of metastatic involvement of the humerus was discovered.

Fig. 4. Case 1. Numerous metastases in skull. October, 1917.

In September of that year (1916) she again came under observation and the X-ray picture showed extensive involvement of the right humerus, the right femur, and the pelvis.

She was not seen again until October of the following year, when she was admitted to hospital in a miserable condition. She was bed-ridden, unable to feed herself, and had spontaneous fractures of both upper arms. Over the vault of the skull were numerous firm nodules. Numerous X-ray studies were made, and an involvement of the skeleton discovered of most remarkable extent. It almost appeared as if not a bone in the body had been spared (Figs. 1, 2, 3, and 4). There were widespread metastases in the skull (the nodules already referred to), the humerus, radius, ulna, femur, tibia, and fibula on both sides, the pelvis, and the small bones of the hands and feet. The fractures of the arms were due to extensive involvement of both humeri.

Arrangements were made for the patient to be sent to a home for incurables in another city, but as that institution was full a delay of 4 months ensued before she could gain admission. During that time the clinical picture underwent a most extraordinary transformation. The nodules in the head disappeared, the fractures of the arms united, strength returned to the legs, she was able to sit up and knit, and by the time she left hospital she was walking about the ward with a little assistance.

Here is one of those singular cases which are occasionally encountered in which the natural defenses of the body triumph over the forces of malignancy. Such an outcome is not rare in slowly growing primary tumors in old people, and the failure of metastases to form owing to the unsuitability of the environment is an everyday occurrence. The disappearance, however, of metastases so widespread as to involve almost every bone of the body and so far advanced that spontaneous fractures had occurred is a phenomenon as startling as it is incomprehensible. It proves beyond cavil that the body may acquire at least for a time an immunity to malignant disease.

Case 2. Mr. W., age 71, had always enjoyed good health until 1913. In that year a pigmented warty growth developed on the plantar surface of the heel. It was removed, found to be a melanoma, and soon recurred at the margin of the scar. It continued to grow and was removed again in 1916, but again recurred.

In 1917 the glands in the groin became enlarged, and have continued to increase in size until now they form a pigmented mass as large as the fist.

The primary growth was removed for the third and last time in 1918.

At the end of 1919 pigmented spots began to appear on the leg between the knee and ankle. These are raised, firm nodules, about the size of a ten-cent piece, some of an intense jet black, others showing little spots of black here and there on the surface. A few months later small pigmented spots appeared on the chest wall and the side of the nose.

At the present time (August, 1920) the leg presents a most classical picture of melanotic sarcoma (Fig. 5), there is a huge pigmented mass in the groin, a marked collateral circulation on the abdominal wall suggests pressure on the inferior vena cava, and a spontaneous fracture of a rib on the right side of a month's standing may indicate involvement of bone.

Most important of all, during the 7 years that the patient has suffered from melanotic sarcoma, for 6 he has been in perfect health and vigor, able to do a full day's work. It is only during the last year that he has not felt strong enough to work, and he has not been confined to bed for more than 2 months.

Here is a patient who, although suffering for 7 years from what is regarded as one of the most malignant of tumors, during 3 of which years there was distant glandular involvement with blood spread for nearly a year, yet remains in excellent health for 6 years and has every prospect of living out the seventh. Such a patient must have a wonderfully high relative immunity which is only now breaking down.

At the same time the general conception of the malignancy of melanomata, as gathered

Fig. 5. Case 2. Metastatic growths of skin in various stages of development.

from statements in the textbooks, is unduly gloomy. As Sampson Handley puts it, the prognosis has been painted in tones as black as the characteristic nodules. It is true that dissemination is terribly rapid in many cases and death may follow in a few months. In others, however, the tissue immunity is sufficient to allow of successful operative interference.

Very rarely the reaction on the part of the tissues is sufficient, temporarily at least, to destroy the secondary growths. Such a case is that reported by Pearce Gould, and referred to by Handley in his Hunterian lectures on melanomata. A small congenital mole was removed from the chest, after it had been growing larger for 3 months. Removal was soon followed by the appearance of tiny nodules in and under the skin. When the patient came under the observation of Gould 9 months later the nodules were scattered over the greater part of the body. A month later it was found that no new nodules had appeared, and that most of those already present were very much smaller. So also were the enlarged lymphatic glands. In the course of a few weeks all the nodules had disappeared with the exception of two small ones. The patient gained considerably in weight. Six months later cutaneous nodules again appeared, and the patient soon died, after being confined to bed only 3 or 4 days.

As in the present case, spread by lymphatic permeation usually precedes blood spread by a considerable period, and if the operation be conducted along the lines advocated by Handley, with removal not only of neighboring glands but of the intervening lymphatics which are also implicated, the patient has a fair chance of life.

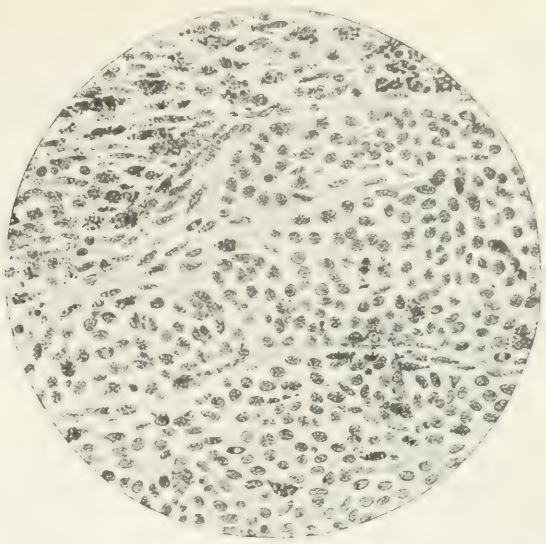

Fig. 6. Case 3. Melanotic sarcoma showing round and spindle cells many of which are loaded with melanin. One mitotic figure is seen.

Case 3. Mr. P., a healthy farmer, age 38, presented himself in March, 1918, with a mass in the axilla on the right side. It had been there since the middle of the previous year, but had troubled him so little that he did not leave his work to come into the city to have it treated. Microscopic examination showed it to be a typical melanotic sarcoma containing a large amount of pigment (Fig. 6). He gave a history of having had a growth of unknown nature removed from the interscapular region 7 years previously.

He made a rapid recovery and did a full summer's work on his farm. In the fall several blackish nodules appeared on the skin of the chest and anterior abdominal wall. These were excised, and proved to be identical in microscopic structure with the mass from the axilla. His health remained unimpaired, but realizing the seriousness of his condition he insured his life as a first class risk.

In June, 1919, he reappeared in hospital suffering from an acute abdominal condition which proved to be an intussusception. At the operation an enlarged gland was found close to the intussusception, and probably the cause of that condition. Sections showed the structure which had already become so familiar.

In September he presented himself again complaining of sore throat, and it was found that the tonsils were converted into two large black masses which were removed with perfect ease. Needless to say they were the seat of melanotic sarcoma.

The patient returned to his farm and continued to work throughout the winter, but in the spring he succumbed rather suddenly, the exact details not being available. He thus enjoyed nearly 3 years of robust health, punctuated though they were with numerous operations.

This case is remarkable for the series of metastases which appeared one after the other in so dramatic a fashion. Although the patient must have been riddled with melanomata he yet enjoyed perfect health, worked hard as a farmer, and actually passed for life insurance.

That a partial immunity against malignant disease may exist is shown by the cases just described. It is possible for the patient to remain in a condition of apparently absolute health while metastases are being formed in a widespread manner throughout the body, very much as if non-pathogenic bacteria established themselves in foci here and there without affecting the general health.

Not only may the metastases be held in check, as it were, by the defensive forces of the body, but they actually may recede and disappear, as in Case 1. There can be no explanation for such behavior as long as our ignorance of the essential nature of neoplasms is so profound. At the same time it is more than probable that in some instances at least the behavior of the metastases is governed and controlled to some extent by the primary growth. Thus it is a recognized fact that removal of the primary tumor in chorioepithelioma may be followed in exceptional cases by disappearance of the secondary growths in the lung.

The fate of a metastasis depends not only on the proliferative activity of the tumor cells, but also upon the behavior of the tissue in which they are implanted. This can be studied very satisfactorily in experimental transplantation.

When a tumor, such as a breast carcinoma in a mouse, is transplanted into a series of mice, it will die in the majority of cases, but in about 5 per cent the transplant will take. After a series of transplantations the tumor becomes so adapted that it will grow in nearly every case. The series of changes that such a graft undergoes is briefly as follows: At the end of 24 hours a connective-tissue reaction can be observed around the graft, the fibroblasts proliferate, and new capillaries are formed. At the same time the stroma of the graft begins to degenerate, and by the third day this degeneration is complete. The new granulation tissue invades the graft, vascularizes it, and by the end of the second week a completely new stroma is formed. The fate of the graft depends entirely on the formation of this new stroma. If this does not take place the graft will die. In an immune animal this new stroma is not supplied, in a susceptible animal it is.

Murphy and his co-workers are of the opinion that the essential immunity mechanism against carcinoma is the proliferation of lymphocytes so frequently seen in the neighborhood of a malignant growth. He has shown experimentally not only that a strong dose of X-rays by injuring the lymphoid tissue of the body, may render the animal more susceptible to the inoculation of tumor fragments, but also that by stimulating the lymphoid tissue by a small dose of X-rays the animal may be made correspondingly immune.

In some cases the new tumor after growing for some time may die. In such a case it is impossible to re-inoculate the animal, which is now immune. Similar immunity can be produced by the inoculation of normal living tissue or of red blood corpuscles. The tissue, however, must be from the same species of animal. Rat tissue will not immunize a mouse. Unfortunately immunity to a growing tumor has not so far been produced, nor can the immunity be transferred passively to another animal.

These facts certainly throw light on the general question of immunity to malignant disease, and the day will come when they can be applied to the production of immunity in man. Until that day dawns we must still regard the knife as the principal weapon against this greatest scourge of humanity.

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RECONSTRUCTION SURGERY AND ITS APPLICATION TO CIVILIAN PRACTICE[1]

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THE term reconstruction surgery has found its way into surgical thinking and writing almost entirely since the recent great war. It implies the surgical attempt to "make over" the defects and deformities of the human frame, resulting from injury and disease. In a very small way most of the problems of war surgery had been observed by many orthopedic surgeons in civilian practice, but the war presented in wholesale fashion an opportunity to study, and attempt to meet satisfactorily, problems which the surgical profession has never hitherto in the world's history been asked to cope with. It is a matter for congratulation that the surgeons, with outstanding leaders and a band of enthusiastic followers, have been successful to a very great degree in overcoming these problems and thus reclaiming to self support and comfort a host of disabled men who would otherwise have been derelicts, dependent upon their grateful countries for their very subsistence. It is with the hope that the lessons learned in dealing with these casualties of the fearful struggle may be made permanent for the treatment of disabilities of civilian life that this paper is presented.

One of the most important lessons learned, and therefore presented first for your thought, is the emphasis placed upon *ultimate function* in the individual, rather than restoration of the contour and anatomical structure of a part. An example which readily comes to mind is the improved function of an arm in a case of loss of the shoulder-joint, which comes by aiming at and securing an ankylosis of the shoulder in good position rather than attempting an arthroplastic operation to restore motion of this joint.

The subject of reconstruction surgery is so comprehensive as to make it impossible to present it in a single paper, but some of the outstanding features will be considered as they relate to the various structures of the extremities: (a) the bones, (b) the joints, (c) the muscles and tendons, and (d) the peripheral nerves.

THE BONES

Bone sepsis. One of the greatest problems in the surgery of the war was that of bone infection. It primarily menaced the life of the patient, and ultimately the function of the limb. That we were never wholly successful in its treatment or control is evidenced by the great many amputations rendered necessary from this cause alone. We are not yet sufficiently far removed from the war to view in proper perspective its results from a surgical standpoint, but yet a sufficient time has elapsed to enable us to judge adequately as to the values of most of the surgical procedures adopted. While it is improbable that in civilian practice we will ever see bone sepsis to the same extent as in war, yet in industrial and railway surgery we have to deal with similar conditions, even if not to such an extreme extent.

Our first consideration is the question as to how far the war methods succeeded in overcoming the problems of sepsis, and, in the light of our knowledge of late results, which of the many methods adopted do we find ought to be perpetuated in civilian practice. Concerning the question of how far the bone infection endangered the life of the individual, we cannot offer any criticism, as only those surgeons who have met these extreme conditions in casualty clearing stations and other hospitals down the line can form a just opinion as to this point. It is certain, however, that, owing to stringency of war conditions, many limbs had to be amputated which might have been saved with the opportunities and time permitted for treatment in civilian hospitals.

The extensive *débridement* practiced in the later years of the war undoubtedly resulted in the saving of an infinite number of lives and resulted in early healing of soft parts in a

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similar number of cases. The value of *débridement* in the soft tissues was early so apparent that many were encouraged to try similar treatment in bone structures, and the result was that in a great many cases, not only were palpably loose pieces of bone removed, but many which had some attachment to periosteum from which they could hope to receive a sufficient blood supply, were removed. In addition some surgeons advocated chiselling away bone surfaces which had been contaminated. This removal of bone practically always resulted in a gap sufficient to prevent subsequent union.

The pathological conditions in soft structures and in bone structures are not analogous, and therefore must be differently handled. From the trauma and infection combined, the soft structures are usually destroyed for some distance beyond the ragged wound itself, as can be determined by the color and the lack of contractility of muscle tissue. These structures become necrotic and make good culture fields; hence their removal is logical. The bone, however, by reason of its structure will not be deeply invaded by infection, and trauma may not widely destroy it, and as no one can tell what fragments will have their circulation restored if left alone, it seems wise, viewing the situation from this distance, to recommend leaving, even in septic fields, fragments which have any attachment from which revascularization may take place. These fragments often form centers of osteogenesis, and may be the factor upon which union depends.

In lesser degrees of infection, and in clean fields, these fragments should always be left. One of the anxieties which faced most surgeons in pre-war days has been largely eliminated, *viz.*, the fear which commonly prevailed that sepsis usually results in non-union. It has been found that not only do septic bone fractures unite in most instances, but when there is non-union it is most frequently due to some other cause.

Mild sepsis is known to be a stimulant to bone granulations, and if apposition of the fragments is secured, even while a portion is being extruded as a sequestrum, union will take place. For this reason care should be taken to secure and maintain proper alignment and length in all septic fractures, with the hope of ultimate union. So important is this factor in treatment, that one is not only justified, but really required, in the interests of the patient, to adjust malpositions, even in the septic stage, before union has taken place. Opening up these cases sufficient to align the fragment, and even holding them in apposition by wire or kangaroo tendon rarely results in a "flare-up" of the infection to do any harm, and numerous cases are available as evidence that this line of treatment is satisfactory and successful. The work done by Major W. E. Gallie, in the Canadian Granville Hospital in Buxton, is most commendable. For the purpose of extension and alignment the greatest credit is due to Sir Robert Jones and his colleagues of the Liverpool school for their success in bringing so generally into use the Thomas splint, and its various modifications, for fractures of the single bones of the extremities. If in civilian surgery the lessons of the war, especially in its later stages, are properly taken to heart, it will result in enormous improvement in results in severe compound, comminuted, and septic fractures of the extremities. If proper use is made of these methods of fixation and extension, much of the reparation or reconstruction surgery, such as osteotomy for malunion, would be eliminated from surgical practice. The transportation of these severe fractures is made so easy for the patient by the Thomas splint properly applied, that every civilian ambulance and first aid center should be supplied with a series of them.

Sequestra and sinuses. As a result of the plugging of vessels from thrombosis in the bone structure, or the cutting off of the blood supply to certain portions of bone by its separation from its periosteal or endosteal supply, necrosis frequently follows, and ultimately the separation of this necrotic area from the balance of the bone. Cloacæ in the bone and sinuses in the soft tissue persist, so long as this fragment remains. It should be recognized that only two conditions can perpetuate a sinus—either a foreign body in its depth, such as a sequestrum, a shell frag-

ment, or bit of infected clothing—or a non-collapsible wall, either bony or fibrous. The treatment of this condition has received a new impetus from the work of war surgeons. The removal of the fibrous wall of a sinus is most easily done by complete excision, and this should be done in exposing the foreign body. Sufficient surrounding bone, which may be healthy, must be removed to expose the sequestrum and permit of its removal. After removal it is sufficient to scrape away the unhealthy granulations forming the bed of the sequestrum, and closure will result. If the bed of the sequestrum is deep, and the wall overhanging so that it will leave a non-collapsible cavity too large to fill in with granulation tissue, the walls will have to be removed to convert the deep cavity into a shallow saucer-shaped one, and permit the soft tissues to fall in and fill the cavity. Care should be taken in this procedure to chisel off periosteum and bone together, and not strip the periosteum back for some distance beyond the saucer edges, as this latter method might result in cutting off the blood supply from a further piece of bone, and necrosis and sequestrum formation might follow. Cavities in bone near the joints, which cannot be treated in this way, yield good results by sloping the sides as much as can be reasonably done, and cleaning out the unhealthy granulations. A generous flap from an adjoining muscle is then switched into the cavity and fastened. Fat or fascia as a filler has not proved satisfactory. It is definitely known that in the healing process infective foci may be surrounded in bone structure and remain latent, to become a source of trouble at a future date if the vitality of the patient is taxed, or to become a source of infection if future operation measures are necessitated for bone graft or other repair.

Periods varying from 6 months to 1 year must elapse before one may feel justified in cutting into this septic bone structure for purposes of repair. A two-stage operation is recommended by many surgeons: first, to remove by excision the soft tissue scar over the area and prepare the site of future graft in the bone, and later to complete the operation by placing the graft.

Bone grafts. Bone grafting has made a place for itself in the reconstruction of bony defects, and the principles underlying its application have been so thoroughly studied and presented that it is not necessary to go into the details as to its use, but it seems wise to emphasize certain points, in order to prevent its misapplication.

In general the inlay graft, as advocated by Albee, has proved the most satisfactory. The intermedullary graft is scarcely ever applicable, owing to the fact that in most cases the medullary canal is destroyed, and again, this type of graft would to a degree endanger the blood supply to the bone ends from the endosteal surface. The homogeneous graft is preferred, not because it is a very active agent in osteogenesis, but from the fact that it is most readily penetrated by osteoblasts, and not so subject to autolysis as foreign bone.

A practical point in the technique which has proved useful may be noted here. The inlay graft, cut with a twin saw, does not fit snugly, and leaves a gap to be filled in with blood. A single saw is now always used, and a diamond-shaped graft cut from the sound tibia. In the case of a single bone like the humerus or femur, a similar-shaped V piece is removed from each bone end, and then the apex of the V is continued up the shaft as a single cut for an inch or more, thus converting the V into a Y. This permits of the diamond graft being driven into one prepared V very snugly, and, by separating the margins with an osteotome, the other end of the diamond is squeezed into the other prepared V. A little practice makes it possible to fit this graft so that no retaining sutures are necessary, and the limb can be lifted without disturbing the graft. In the thin bones of the forearm or fibula, a single saw cut up the center is all that is necessary to receive the diamond graft. This tightly fitting graft is highly satisfactory. Three months' immobilization of the limb is necessary to ensure good union. It would seem almost unnecessary to suggest that in no instance can a steel plate screwed to the bone fragments across a fibrous non-union ever result in union, and yet one still sees cases in which such an operation has been performed. The fibrous tissue must be removed from

between the ends and the sclerosed bone ends cut through until bone is reached which contains living bone cells capable of osteogenesis. The sclerotic bone end containing no bone cells varies in depth, depending upon the length of time the non-union has existed and the degree of trauma inflicted. In the single bones, as the humerus and femur, the ends should be brought together, as bridging a gap will not usually result in a strong useful repair. In such single bone it has been found satisfactory often to make a picket of one end and cut a V piece in the other, bringing the ends together firmly in this way, and fastening them with wire or kangaroo tendon. When a gap occurs in one of the double bones of an extremity, the gap may be successfully bridged by such a graft, and it is not found desirable to shorten the other bone to lessen the gap.

In civilian life, as in army practice, the two great causes, aside from constitutional conditions, of non-union are lack of apposition, and the interposition of some structures between the bone ends, which subsequently is changed into fibrous tissue. The same principles are applicable in the treatment of both conditions.

JOINTS

In the joint conditions of the war, the greatest menace to life and limb was infection, and in the early stages it was responsible for many of the amputations, especially when there was associated massive comminution of the bones forming the joint. This was primarily due to the difficulty of adequately draining the large joints, such as the shoulder, knee, and hip.

Sufficient time has elapsed in a great many of these cases to permit of a study of the end-results of the various methods adopted, and the writer's impression of these is presented. By virtue of the writer's position as orthopedic consultant to the army in Canada since the armistice, opportunity has been presented of seeing most of the cases in all of the hospitals from Halifax to Victoria. In the through-and-through bullet wounds, even when the bones were penetrated, it was a perpetual source of surprise to see so many with very little impairment of function of the joint. In most of these there was no infection, the wound healing in 10 days or 2 weeks. In the widely infected joints treated by drainage and various methods of flushing with disinfectants, ankylosis of the fibrous or bony type usually occurred. If the joints had been placed in good position, the degree of usefulness of the limb was very great, but it unfortunately happened that the greater percentage of these cases was not in the most useful position, and consequently required operative interference, such as osteotomy, to correct this defect. It should be emphasized that much of the reconstruction surgery that one is called on to do is preventable, and the chief value of a paper of this sort will be lost unless this point is made very clear. It is just as easy to place a limb in such a position that the best functional result will be obtained, if ankylosis should occur, as it is to place it in a bad position. In the main the malpositions in fractures also are unnecessary, as are also many of the contractions and fixations of the tendons in their sheaths, etc. The best positions for ankylosis of the various joints, for usefulness in the ordinary normal occupations, are in the writer's estimation as follows:

The *shoulder-joint* in abduction of about 45° from the side of the body, and with the elbow slightly in front of anterior axillary line.

The *elbow-joint*, if single, at angle of flexion of 110°, or slightly straighter than a right angle; if double, one arm, preferably the left, at 120° of flexion, and the other, the right, at 75°, or slightly more acute than a right angle. If pronation and supination are lost, the forearm should be placed in slight pronation, about half way between the mid-position and complete pronation. Many of the cases with loss of pronation and supination can be remedied by a removal of the head of the radius, and a useful range of motion secured.

The *wrist-joint* should be fairly markedly hyperextended, as only in this position can the flexors of the fingers act to advantage.

The *hip-joint* should be in abduction, and slight flexion of about 15°.

The *knee-joint* should be straight in all workers, and only in very exceptional occupations, such as professional callings, should any flexion be permitted.

The *ankle-joint* should be at right angles to the leg, except in some cases in which there is a fairly large degree of shortening of the extremity when a toe drop is permissible.

These statements seem axiomatic, and yet that they are not acted upon is evident, because of the great numbers of operations done solely to improve positions to secure greater usefulness. Osteotomy of the humerus below the head to secure greater abduction, osteotomy of the humerus at the lower end to secure greater or lesser degrees of flexion at the elbow, osteotomy of both bones of the forearm (the radius at its neck and the ulna at its lower end) to correct a faulty position, are frequent operations upon the upper extremity, in our military surgical clinics. It is surprising how many forearms are fixed in complete supination—an almost useless functional position. In the lower extremity the most frequent fault is the adduction flexion deformity at the hip, and an open intertrochanteric osteotomy, with removal of a small wedge with the base outward, is the common method of correction. In practically no case is an arthroplasty recommended in these cases of ankylosis. In the few cases seen which were attempted, a useful joint was never secured.

In civilian life, in certain clean cases of fixation, in selected occupations, an arthroplasty will give a satisfactory functioning joint, but for manual laborers, the results are not so satisfactory as a fixed joint in the position of election.

In the infected joints with marked comminution of bones, the cases which were not primarily amputated were, in the early stages, often widely excised. It is not in a spirit of criticism that attention is called to the fact that most of these cases have resulted in flail, and, for the most part, useless joints. It was thought wise, in all probability, by the surgeon first seeing such a case in front line work, thus to excise widely the joint to secure adequate drainage, and thus save the patient's life.

From the standpoint of end-results, it certainly is wise, when excision is done early, to remove as little bone structure as will accomplish the purpose of efficient drainage, and subsequently to keep up extension for so short a time as possible, in order to allow the excised ends to approximate. In a very small number of the flail joints, the function has been sufficiently good to warrant no surgical interference, the patient being an accountant, or professional man. In the bulk of the cases, arthrodesis has been advocated. This has been difficult to accomplish in the elbow and shoulder. Union has usually been secured in the elbow by dovetailing the forearm bones into the lower end of the humerus and fixing with a bone screw. In the shoulder-joint the best results seen have been by an operative procedure devised by the writer. A flap of the deltoid is turned up to expose the joint freely. The upper end of the humerus is then chiselled off to form a picket shaped end, flattened laterally. The glenoid cavity is modelled with a chisel, removing a flat section of its face, deepest at the upper end, and cutting this off at the upper end by a cut at right angles to its face. This leaves a flattened surface, into which can be fitted the picket end of humerus. The overhanging acromion process is then chiselled away on its lower surface, and a cut from above downward is made with a chisel at the line of the glenoid, about two-thirds through its base. This fragment is then broken down and crowded into position, so that the denuded under surface comes in contact with the outer prepared surface of the humerus. A bone pin is then driven through this displaced acromion, through the humerus, and well into the body of the scapula. This will firmly fix all structures at any angle of abduction desired, depending on the angle of cut in the glenoid.

MUSCLES AND TENDONS

The extensive *débridement* practiced in the later periods of the war in an endeavor to overcome sepsis, resulted in extensive scars and adhesions. The ultimate function of these limbs, when the excision of tissue was from the large and bulky muscle structures of the gluteal region or thigh, and in many cases of the upper arm, has been exceptionally good, and warrants similar practice in these regions, when necessary, in civilian injuries with infection. The amount of function of the remnant

of muscle left after excision of a large portion of its substance, is encouraging, if the nerve supply to this remnant remains intact. In the forearm and leg, where tendons have been extensively exposed, the tying down of these structures by adhesions has resulted in great loss of function. In many cases the baneful effects have been overcome by tendon transference, but in many the function is irreparably lost. Only very grave immediate danger to life will warrant the continuance of such *débridement* in these regions.

It is possible, in the forearm or hand, to separate the adherent tendons as advocated by Kanavel, and by surrounding the tendons by fascia covered with fat a useful hand can be hoped for in some cases, but in the main these results are not brilliant.

Probably no department of the Medical Service has produced more dramatic results than those obtained in restoration of function following tendon transference in irreparable nerve injuries. This subject has been given a great impetus as a result of this work and its further development and employment in the paralytic conditions of civilian practice is inevitable. Preceding the war, most of the work of tendon transference had been done on the lower extremity, as it was felt that the intricate and complex movements of the forearm and hand were not likely to be greatly improved. During the war, however, it has been demonstrated that the upper extremity lends itself most admirably to this type of surgery, especially where the demand has been for movement, without too much strain.

In the lower extremity the transferred muscle has not only to take on the function of movement of the part, controlled by the replaced muscle, but has to stand the strain of weight-bearing as well. The result frequently has been that the strain is too great, and the function imperfect, or lost.

In the upper extremity, where strain can be limited, and movement is the essential factor, the results have been most happy.

The principles upon which this work is based are simple, and yet unless they are understood and adhered to, good results cannot be attained. So far as possible, muscles with a function similar to that they are to undertake, should be used; extensors for extension, flexors for flexion, etc. The line of pull should be as straight as possible, so that the origin of the muscle and its new insertion shall have as direct a pull as possible. The suture of transferred tendons should be made under some tension, and the strain relieved by position. This is essential, as it is not always possible to get a straight pull at first, but this straight line is assured at a later date, and consequently the muscles are relaxed. Also the line of suture usually gives somewhat. The suture material should be a non-absorbable suture, such as linen, as tendon structures unite slowly, and catgut often absorbs before union is strong enough to stand the pull put upon it with use.

If it is necessary to use a muscle the function of which is not the same as the one it is to supply, such as a flexor to take the place of an extensor, the whole muscle must be used. It is not possible to split off part of a flexor and transfer it to an extensor and hope that it will functionate. This would be to expect the muscle belly by its contraction to flex at one time and extend at another the member it controls. When the muscle of an opposing group is used, it must not be expected to function in its new position without a fairly long period of re-education. The active use should be commenced early, at the end of 3 weeks, to secure the best results. The limb for the first 3 weeks should be put in a plaster splint, in a position to relax the sutured tendons.

The most satisfactory of all of the tendon transfer cases is that for wrist and finger drop, as result of an irreparable musculospiral nerve lesion. Here the pronator radii teres is detached from its insertion into the radius, and carried through the wrist extensors—the extensor carpi radialis longior and brevior—and stitched to the tendinous portion of the long wrist extensor, the wrist being hyperextended to make it taut. The flexor carpi radialis is detached from its insertion and carried in a direct line through the subcutaneous fat to its insertion, into the four common extensor tendons at the wrist, including the extensor minimi digiti. The palmaris longus is similarly detached and carried in the

same plane to the extensor surface and attached to the three extensors of the thumb—the extensor ossis metacarpi, the extensor primi, and extensor secundi pollicis. These tendons, transferred after scraping the sheath completely off, are sutured into a split in the tendons to which they are transferred, and double stitched with linen. The hand and forearm is encased in plaster with hand, fingers, and thumb completely extended. At the end of 3 weeks, musle training is commenced, and continued for 2 months. Improved function of an extremity in cases of paralyses where tendon transference is not possible, is secured by a fixation of the paralyzed tendon above the joint, as described by Gallie.

In cases of wrist drop, where flexors or pronators are not available, the wrist extensors may be planted into a groove in the radius and ulna above the wrist-joint, with the hand in the position desired. In 6 or 8 weeks these tendons become firmly fixed, and secure the permanent extension of wrist.

In a similar way in drop foot from paralysis, the peroneus brevis and tibialis anticus may be planted into a groove in the tibia and fibula above the ankle, and will secure the foot in a right-angled position.

NERVE INJURIES

Owing to the fact that thousands of cases of nerve injury have been available, it has been possible to study the problems presented, and to systematize our knowledge of the results. Taken as a whole the results of suture of injured nerves has been disappointing, but there has been a tremendous gain in our knowledge of these conditions and methods of dealing with them. The nerves which are wholly motor or wholly sensory have yielded infinitely better results after treatment than the mixed ones.

Probably the best results secured have been in the musculospiral and sciatic nerves; the poorest in the ulnar. The reason for greater percentage of failures in the mixed nerves has been probably due to our inability to coapt similar areas in the proximal and distal ends so that motor axones will find their way into motor areas and sensory into sensory. The study of Stoeffel into the topography of the peripheral nerves may make it possible in the future to determine the various tracts in both ends of a cut nerve, and let us approximate so that sensory and motor tracts will be in their right relation.

Certain other facts have been brought out which are of interest. The nerves sutured early after injury have done better, and a larger percentage of recoveries have resulted than in the ones sutured long periods after the injury, with subsequent long-continued infection. Primary suture in the presence of infection very rarely results in recovery without second operation for removal of scar tissue from the nerve. This, however, is not an argument against primary suture when the end of the nerve can be readily found at time of early *débridement* or drainage operation. The primary operation has served the purpose of keeping the ends approximated, and they are thus readily found, doing away with the necessity of so extensive an operation to locate widely separated ends. It also keeps the length, and long gaps are not so frequent.

The indications for operation have been so frequently the subject of papers that they will be touched only briefly in passing.

If a muscle response to faradic stimulation is lacking, the galvanic response is noted as to whether it is brisk or sluggish, and the condensor reaction noted, with the number of microfarads at a definite voltage recorded.

Treatment by galvanism, to the point of visible muscle contraction with massage is carried out daily for a period of say one month, and the reactions again noted. If the galvanic response is more prompt and the condensor report lowered, it is wise to continue treatment for a further period. If, however, the reverse is true, than a block is assumed. End-to-end suture has been the only satisfactory method of securing restoration. The fibrous ends are cut back until nerve bundles are seen definitely to pout, and then the union is made by suture of the sheath by interrupted plain catgut No. 0. The suture must be accomplished without undue tension, the nerve being freed for long distances above and below, to secure approximation, and in cases where it is possible the

nerve may be displaced and transferred, to secure a shorter line. The limb should also be placed in most favorable position to secure relaxation.

The line of suture was in early cases covered, various materials such as fascia lata, Cargile membrane, fat, or tube of vein being used for this purpose. These have been given up, and the line of suture is laid in a bed of clear muscle tissue when possible, and the wound closed. In no circumstance has the writer seen recovery where gaps have been bridged either by nerve grafts, by tubulization by veins or fascia, or by connecting the ends by catgut strands.

A few interesting examples of nerve transfer have been noted, such as that reported by Harris, of the transfer of the proximal end of the normal radial to the distal end of the destroyed median just above the wrist. This has resulted in complete restoration of sensation over the anæsthetic median area.

VESICOSIGMOIDAL FISTULÆ[1]

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IN the study of vesicosigmoidal fistulæ, which are of relatively infrequent occurrence, it may be advisable to review the embrylogical development and the relations of the involved organs. Bailey and Miller have said in substance, that the cloaca originates from the dilated caudal end of the allantoic duct, and its cavity is separated from the outer surface of the embryo by the cloacal membrane which is composed of a layer of entoderm and a layer of ectoderm with a thin layer of mesoderm between. The cloaca then becomes separated into two parts, a large ventral part which forms the urogenital sinus, and a smaller dorsal part which forms the rectum. The slightly larger cephalic part of the urogenital sinus becomes the anlage of the urinary bladder, while the smaller caudal part becomes the anlage of the urethra. The sigmoid develops from the caudal end of the primitive gut. "The rectum and sigmoid unite leaving a terminal sigmoid constriction in 80 per cent of the cases" (13).

It has been my privilege to make about 1,000 proctoscopic examinations at the Mayo Clinic, and in approximately 80 per cent of the patients a terminal sigmoid constriction could be demonstrated, that is, there was anatomical obstruction to the passage of the proctoscope. The obstruction, however, may have been influenced in some instances by the mesentery of the sigmoid and the shape of the sacrum. This constriction is a probable cause of diseases of the rectum, such as the accumulation in excess of gases and fæces, of acquired diverticula, of diverticulitis, of localized acute infections, of chronic infections, and of secondary malignancies.

Piersol (17) states that the sigmoid flexure begins at the crest of the ilium as a loop of varying length and shape, and ends at the middle of the third sacral vertebra. Its usual length is from 25 to 56 centimeters. It has a mesenteric attachment and may be free, or it may be bound down closely. As the sigmoid flexure descends along the sacrum it usually curves to the right and crosses the median line. The urinary bladder, ileum, sigmoid, and female pelvic organs are all in close proximity.

Pascal, in his study of the literature of vesicosigmoidal fistulæ up to 1900, found 206 cases. Forty-two were added to this number by Pristavesco and, in 1915, 8 additional cases were added by Cunningham, making a total of 256 reported cases. Seventy-five per cent of the patients in this series were females and 25 per cent were males. Cripps found 17.46 per cent of 63 cases of enterovesical fistula to be vesicosigmoidal. Chavannaz found the frequency of the vesicosigmoidal variety to be 24.07 per cent, and Parham and Hume placed it at 33 per cent. Bryan made an excellent

[1] From the Section on Urology, Mayo Clinic, Rochester Minnesota.

study of 52 vesicosigmoidal cases from the literature, adding thereto one case of his own.

Cripps states: "Research into the subject shows indisputably that enterovesical fistulæ are far more commonly the result of inflammatory mischief than due to perforation from cancerous growth . . . . These records extend over nearly two centuries, from the time when old Anthony Fathergill thought the disease might be cured by a course of Bristol water and ass's milk, to the cases successfully treated by colotomy, published by Mr. Bryant." Cripps found that 3 cases were due to simple ulcer, although often tuberculous origin was suspected. One case apparently was due to an ulceration from an abscess originating in a diverticulum of the bladder.

ETIOLOGY

Either directly or indirectly, diverticulitis of the sigmoid (11) may be a factor in the production of vesico-enterosigmoidal fistulæ (3, 7, 20). Diverticula may be congenital as in the Meckel type, or they may be acquired. In 1907, Wilson introduced and applied the term "diverticulitis" (13) to cases in which acute inflammation of the mucosa occurred within the diverticula; and "peridiverticulitis" to cases in which chronic inflammations of the subserosa occurred around the diverticula(14). In 1908, Telling, in his excellent contribution on acquired diverticulitis, mentioned etiological factors as follows:

1. Age varying from 55 to 67 (80 patients);
2. Fifty-five of 81 patients males, and 28 females;
3. Previous or present obesity of the patient;
4. Cachexia and absence of obesity, in many instances following previous obesity;
5. Local structural yielding of the walls of the large intestine;
6. Abnormally long retention of fæcal material in the sigmoid, producing increased internal pressure;
7. Pressure from within the bowel: (a) constipation, and (b) flatulence;
8. Relation of diverticula to points of entry of vessels through the gut walls;
9. Variation in the size of the vessels, as in venous congestion and subsequent reduction;
10. Congenital predisposition with regard to the amount and laxity of connective tissue surrounding the vessels at these points;
11. Muscular deficiency of the gut walls.

Telling illustrates the pathological changes that may occur in the diverticula as follows:

1. Infection of the general peritoneal cavity from thinning of the sac walls without perforation;
2. Acute or gangrenous inflammation (diverticulitis);
3. Chronic proliferative inflammation with thickening of the gut wall and stenosis of the bowel;
4. The formation of adhesions, especially to the small intestine and bladder;
5. Perforation of the diverticulum, giving rise to (a) general peritonitis, (b) local abscess, (c) submucous fistulæ of the gut wall, and (d) fistulous communication with other viscera, especially the bladder;
6. The lodgment of foreign bodies;
7. Chronic mesenteritis of the sigmoidal loop;
8. Local chronic peritonitis;
9. Metastatic suppuration;
10. The development of carcinoma (10);
11. Perforation into the hernial sac.

In 1912 McGrath mentioned among "pathologic processes," observed by various authors, "which resulted from infection through intestinal diverticula: acute or gangrenous inflammation of sigmoid diverticula with symptoms so closely simulating appendicitis as to suggest a transposition of the viscera. Perforation followed by localized abscess or general peritonitis has resulted from this process. . . Perforation resulting in general peritonitis, local abscess formation, submucous fistulæ, and fistulous communications with other structures. Sudden perforation with resultant general peritonitis has followed straining at stool. Abscesses have formed in the intestinal wall, outside the wall, and surrounded by coils of small intestine, in the mesentery and extending to the liver and left kidney. Abscess formations have simulated carcinoma. Fistulous tracts have resulted between the sigmoid and the small intestine, the abdominal wall, and, most frequently, the bladder. Sudden perforation into the bladder has occurred on lifting a heavy weight. In some cases the fistulous communication was direct between a diverticulum and viscus, but in others it occurred by way of an interposed abscess cavity."

Although diverticulitis is found more often in adults, and especially in the aged, occasionally it is found in children. Ashhurst reported

TABLE I.—MODIFIED CLASSIFICATION OF ETIOLOGICAL FACTORS IN VESICOSIGMOIDAL FISTULA ACCORDING TO PASCAL, BRYAN, AND CRIPPS

A. Traumatic:
  1. Accidental
    a. Gunshot or shell splinter
    b. Surgical
    c. Injury; labor or perforation of the bowel by foreign body from within or from without
  2. Intentional
    a. Self-inflicted wounds by the insane
B. Nontraumatic:
  1. Inflammatory
    a. Abscess: tuberculous; amœbic; gonorrhœic; actinomycotic; typhoidal; bacillus coli
    b. Stricture: syphilitic; secondary to inflammatory ulcer within the gut; secondary to inflammatory process without the gut but adjacent to or surrounding it
    c. Stone
    d. Ulcer: simple; tuberculous; amœbic; syphilitic; typhoidal; actinomycotic; ulcerative colitis
    e. Diverticulitis: sigmoid; bladder
  2. Tumors
    a. Benign
    b. Malignant } extrinsic or intrinsic
  3. Congenital anomalies

one case of a child aged 5, and Walcha reported one of a child aged 10.

A modified arrangement of Pascal's, Bryan's, and Cripps's classification of etiological factors in vesicosigmoidal fistulæ is given in Table I.

REVIEW OF THIRTY-FOUR CASES

A review of the 34 cases of vesicosigmoidal fistula (Table II) in which operation was performed demonstrates a great preponderance of the type due to inflammation and infection in contradistinction to the fistulæ due to malignant conditions (Table III), the ratio being 14.50 : 1, and to those of traumatic origin, the ratio being 9.66 : 1.

In our series of cases the etiological infection was in organs adjacent to the bladder, such as the appendix, the sigmoid, the rectum, and, most often, the fallopian tubes (38.23 per cent). It may be assumed that an infective process could begin in a diverticulum of the bladder, or in diverticulum with stone, causing a peridiverticulitis and ultimate erosion into the sigmoid. Cases have been reported of advanced malignant disease of the bowel that extended from the bladder into the adnexa by direct extension and infiltration.

TABLE II.—TYPES OF FIFTY-NINE VESICO-ENTERIC FISTULÆ OPERATED ON AT MAYO CLINIC (JANUARY 1, 1907, TO JANUARY 1, 1920)

	Cases	Per Cent
Vesico-enterovaginal	1	1.69
Vesico-enterorectal	1	1.69
Vesico-appendiceal	3	5.08
Vesico-ureterorectal	3	5.08
Vesicorectal	3	5.08
Vesico-ileal	13	22.03
Vesicocæcal	1	1.69
Vesicosigmoidal	34	57.62
Single vesicosigmoidal	21	61.76
Multiple vesicosigmoidal	5	14.70
Complicated vesicosigmoidal	8	23.52
Vesico-ileosigmoidal	4	11.76
Vesico-ileocæcalsigmoidal	2	5.88
Vesicorectalsigmoidal	2	5.88

Diverticulitis of the sigmoid is considered by some observers the most predominant cause of vesicosigmoidal fistula. It is possible that because of the interest taken in the subject this type of case is reported, and others are neglected. Twenty-two (52.38 per cent) of the 42 cases from the literature reported by Bryan were due to diverticulitis of the sigmoid. In the cases from the Mayo Clinic, only 6 (17.64 per cent) of 34 were due to diverticulitis of the sigmoid. The ages of the 6 patients were 27, 43, 49, 54, 56, and 61. Three other patients not regarded favorably for operation had vesico-enteric fistulæ and gave histories simulating sigmoidal diverticulitis, yet the true etiology remained obscure. In Case A 186203 of this series is seen a marked instance of recurrent diverticulum. A diverticulum of the sigmoid had produced a vesicosigmoidal fistula and recurrence of the symptoms ensued 9 months later. At the second operation it was found that a new acquired diverticulum had formed in which a diverticulitis later developed and became the cause of a second vesicosigmoidal fistula. The sigmoid was removed by a Mikulicz resection, making the re-formation of diverticula im-

TABLE III.—ETIOLOGICAL FACTORS IN THIRTY-FOUR CASES OF VESICOSIGMOIDAL FISTULA (MAYO CLINIC)

	Cases	Per Cent
A. Traumatic	3	8.82
1. Accidental		
a. Gunshot (A54223)		
b. Surgical		
Colon nicked (elsewhere) (A148184)	3	8.82
Perforation of uterus and small intestine from dilatation and curettage (elsewhere) (A79288)		
B. Nontraumatic	31	91.17
1. Inflammatory		
a. Abscess		
Left ovarian, surgical accident (elsewhere) (A24056)		
Right ovarian (A47407)	3	8.82
Bilateral ovarian and perforated appendix (A89618)		
Salpingitis		
Bilateral (A48609)		
Bilateral (A25406)		
Bilateral (A4553)		
Bilateral (A245457)		
Bilateral (A291181)	9	26.47
Right (A8463)		
Left with foreign body (A9513)		
Left (A15387)		
Dermoid cyst right broad ligament (A15509)		
Tuberculous salpingitis		
Bilateral (A273740)		
Bilateral (A233622)	3	8.82
Tuberculous left tube and ovary (A156564)		
Tuberculous peritonitis		
Tuberculous peritonitis (A273740)		
Tuberculous postoperative fæcal fistula (A76615)	3	8.82
Tuberculous and suppurative appendix (A75616)		
Appendiceal		
Perforated appendix with abscess (A44697)		
Perforated appendix and general peritonitis (A75616)	3	8.82
Gangrenous appendix and general peritonitis (A113006)		
Postoperative		
Abscess of left ovarian region (A140514)	2	5.88
Abscess with fæcal fistula (A104374)		
b. Diverticulitis		
Sigmoid (A52670)		
Sigmoid (A186203)		
Sigmoid (A291938)		
Sigmoid (A291863)	6	17.64
Sigmoid (A252703)		
Sigmoid (A287296)		
2. Tumors	2	5.88
Malignant		
Carcinoma of the rectum, posterior resection (A7873)	2	5.88
Carcinoma of the sigmoid (A262867)		
Females	26	76.47
Males	8	23.52

possible, and thus eliminating the chance of development of a fistula from such a source.

Diverticulitis of the sigmoid is accompanied by pain and colic, usually in the left lower quadrant of the abdomen, and may give symptoms and signs similar to those in periodic attacks of appendicitis. Many investigators have discovered a secondary carcinoma arising on an old diverticulum which in turn has produced a vesicosigmoidal fistula. The signs and symptoms of such fistulæ due to a primary carcinoma of the sigmoid are of relatively short duration, and they are quite easily distinguished from the recurrent signs and symptoms of diverticulitis with the ultimate increase in severity and activity of a superimposed carcinoma (11). Elsewhere I had opportunity to see a case of vesicosigmoidal

TABLE IV.—CYSTOSCOPIC FINDINGS* IN TWENTY-SIX CASES

Case	Condition of mucosa of bladder			Location and size of fistula	Ureters		Remarks
	Normal	Inflammation			Right	Left	
		Localized	Diffuse				
148184	+			Posterior dome	Normal. Not catheterized. Urine clear	Same as right	
79288		At base, 2		Large irregular tear; right posterior wall above floor			
24257			Marked	Slit 1.3 cm. in left posterior roof	Normal. Clear urine	Urine absent for 10 minutes	Impassable stricture left ureter 9 cm. from meatus
47497		Granular tissue around fistula	Slight	Opening in roof of bladder 4 cm. in diameter	Normal	Same as right	Odor of hydrogen sulphide in catheterized urine
48609	+	Small area around fistula		Small pin point opening 3 cm. directly back of left meatus	Normal	Normal	
24515			Acute and chronic, 4	Marked cystitis probably due to bladder stone obscuring location	Not seen; not catheterized	Same as right	One bladder stone, 3. (Nucleus – mushroom tip of retention catheter)
201181		Right and left base and posterior wall, 1			Normal; not catheterized	Same as right	
16609		Surrounding mucosa eroded	Slightly	Half way up posterior wall of bladder	Could not be found	Eroded; not catheterized. Function normal	Ten years' duration
194278		Granulation at base, 3	Acute and chronic, 3	Left trigone	Not observed; not catheterized	Same as right	
233622		Ulcerations at left base, 4	1	Left base	Not observed; not catheterized	Same as right	Cystogram showed outline of rectum and lower sigmoid. Bladder represented by a small irregular area. Catheter passed into fistula
150593		Granulation and bullous œdema of left wall and dome		Left roof and posterior wall	Normal. Not catheterized. Clear urine	Same as right	
273749		4		Posterior wall. Ribbon of thick pus oozing from area 4 cm. in diameter	Normal. Not catheterized	Same as right	Abscess draining from posterior wall into bladder
088505			1	Above and to the outer side of the left meatus	Gaping; contraction, length, function normal. Clear urine	Normal. Clear urine	Bladder appears to be held by adhesions to other organs
44097	+			Posterior wall just above base	Normal	Appearance and urine normal. Obstruction 18 cm. up	
75616			2	Right posterior wall	Gaping; contraction, length, and function normal. Clear urine	Same as right	Fistula discharging mucoid substance
140514		Chronic, 2; posterior wall and posterior dome about fistula, 1; trigone 1. Rest of bladder clear		Posterior upper wall	Normal. Urine clear. Not catheterized	Same as right	Definite opening not found, either visually or with a pointed 4 catheter. Stellate scar observed
113090	+	Posterior wall about the fistula, 3		Posterior wall and covered by a fold of the bladder	Normal. Clear urine	Same as right	
191875		Few areas, 2. Ulceration on posterior dome and granulations	Posterior wall and dome, 3	Posterior dome	Normal. Urine, pus 3, red blood cells, 3	Normal. Pus 3	Diagnosis: vesicoenteric fistula with moderate ascending bilateral pyelonephritis.

* Graded on a scale of 1, 2, 3, 4.

TABLE IV. CYSTOSCOPIC FINDINGS IN TWENTY-SIX CASES (*continued*)

Case	Condition of mucosa of bladder			Location and size of fistula	Ureters		Remarks
	Normal	Inflammation			Right	Left	
		Localized	Diffuse				
186203		2-21-17; areas 2, trigone 2. 7-29-18; left wall and base, 3		2-21-17; left wall and base back of trigone. 7-29-18; left wall and base back of trigone	2-21-17; normal, not catheterized. 2-21-18; normal, not catheterized. Clear urine	Same as right	
52670		Granular, necrotic	Moderate	Roof left side of bladder	Normal contractions	Same as right	Roof not rigid nor bound down as in malignancy
201938		Posterior left wall and dome, 2		Funnel-shaped depression in left dome surrounded by granulation tissue	Normal	Normal	Negative ray with leaded catheter in left ureter
201803			4, especially base and right wall	Posterior to right meatus and partially involving it	Normal. Clear urine. Pus 1, red blood cells 1. Phenolsulphonephthalein 6 per cent in fifteen minutes	Normal. Clear urine. No pus. Red blood cells 1. Phenolsulphonephthalein 6.5 per cent in fifteen minutes	
252703			1	Eroded depressed area in dome; fistulous opening	Normal; not catheterized	Same as right	Cystogram normal. Prostatic obstruction, fullness, and bilateral intravesical enlargement 2. Overlapping 1. Residual urine one ounce
287296			Acute, 4	Not seen. Granulations covered entire base	Not seen	Not seen	Much pus in bladder
7873			Marked	Vesico-enteric fistula. Location not stated	Not seen	Not seen	Two large bladder stones, 1; possibly recurrence of cancer, 2
262867		Area of necrotic granulations with carcinomatous appearance	4				Fæcal odor of urine

fistula due to a primary carcinoma of the sigmoid, later demonstrated at necropsy. The onset was sudden and the history of short duration. Some cases of vesicosigmoidal fistula due to a primary carcinoma may run a severe and brief course, and because of the general syndrome the patients may not have presented themselves at a surgical clinic. Possibly because of this, my statistics on carcinomatous etiology may not be complete.

Vesico-enteric fistulæ due to infective or inflammatory agents are usually secondary to abscess formation or reduced resistance of the tissues, which are devoid of drainage or have inadequate drainage, and following the laws of gravity or the lines of least resistance they point through and rupture into the urinary bladder. Fistulæ due to trauma are dependent both on the seriousness of the wound and secondary infection (Tables I and III).

CYSTOSCOPIC EXAMINATION

The cystoscopic examinations (4) of 26 of the 34 patients (Table IV) showed a fistulous opening in the posterior wall and dome of the bladder, in 7 (26.92 per cent) in the posterior wall and in the dome in 8 cases (30.76 per cent). The fistulæ were definitely to the left in 9 cases and to the right in 3; the incidence was influenced largely by the close proximity of the left bladder wall and sigmoid, although the primary focus may have arisen from other adjacent organs. In 5 cases the fistulous opening was in relatively close proximity to the left ureteral meatus and in 1 it partially involved the right meatus. If granulations are abundant about the fistula and the meatus, and a spurt of urine does not distinguish the openings, as in Case A 233622, the catheter may be passed either into the fistula or the ureter, which would be shown only in the roentgenograms.

Diffuse inflammatory changes occurred in 15 patients; in 5 it was but slight, in 3 moderate, and in 7 marked. In 13 cases there were areas of inflammation surrounding the fistulous opening ranging from simple hyperæmia to exuberant granulations, bullous œdema, ulcerations, necroses, and erosions. Outside of these areas the bladder mucosa was normal in 8 cases (30.76 per cent); and it was found to be entirely normal in 2 (7.69 per cent). A probable cause for the usual freedom from a diffuse cystitis is that distinct lymph channels are absent within the mucous membrane (18); that the mucosa is made up of transitional cells of the expansile, protective, and non-absorbable type, and that the amount of infective material is being diluted and kept more or less in motion by the ingress and expulsion of the urine, and by muscular activities.

The duration of the bladder symptoms in the 34 cases was given by 28 of the patients approximately as follows: Two were free from symptoms; one had symptoms for 1½ months; one for 2 months; one for 3 months; 2 for 4 months; 4 for 6 months; 3 for 7 months; 6 for 1 year; 2 for 1 year and 6 months; 1 for 2 years; 3 for 3 years; and 2 for 10 years prior to examination. Twelve therefore had symptoms for less than 1 year; 14 for 1 year or more and 2 for more than 3 years; in the latter the symptoms of very mild diffuse cystitis (1 on a scale of 4) with erosion or ulceration about the fistulous opening extended over a period of 10 years. The average duration of symptoms of patients with a marked cystitis was nearly 1 year.

The inflammatory changes were largely due to (1) the size of the fistulous opening, (2) the amount and character of the bowel contents and foreign bodies passing into the bladder, (3) urethral obstruction, as in stricture or hypertrophied prostate, and the amount of residual urine, and (4) the type of infective organisms. Besides other types of urethral obstruction, the urethra may become clogged by a fæcal mass, or other foreign body, which not only causes paroxysms of pain but may help to distend the bladder, especially if the fistulous opening is valve-like. In this manner infective agents may be induced into the ureteral openings and cause an ascending ureteropyelonephritis, either by direct extension or implantation. This, however, rarely occurs. In this series there was but one such case. Obstruction was encountered in two catheterized ureters, one of which was seemingly functionless; in two of these cases cystitis was marked. Three meatus were gaping but the urine from all was clear. If the contents of the bladder are obviously infected by ureteral catheterization, a pyelitis may arise in a kidney that otherwise would remain healthy. Seventeen ureters were catheterized and pus was found in only three. Secretion was absent in one.

Care must be used in searching the suspicious inflammatory area for the fistulous opening with a small pointed catheter, for the tissue is often œdematous and friable. I have passed a pointed No. 4 catheter into the tissue, but not far enough to do damage, with as much ease as though it were passing into a small fistula. The danger lies in making new fistulous communications in the surrounding inflammatory tissue with the possibility of passing the catheter into the peritoneal cavity, and carrying infective organisms with it. In cystoscoping one patient (Case A 140514) I could easily see a stellate scar on the posterior upper wall of the bladder, but after a reasonable amount of effort to demonstrate the opening (because of the positive history of berry seeds and gas having passed through the bladder), the attempt was abandoned. During the operation Dr. Judd traced a fistulous tract from the sigmoid to the region of this scar but no opening could be found, thus demonstrating that vesico-enteric fistulæ of infective and inflammatory origin at times heal spontaneously. The postoperative results in our series demonstrate that many of the recurrent fistulæ slowly and gradually diminish in size and may ultimately heal.

Vesicosigmoidal fistulæ may also be shown by the cystogram and the use of sodium bromide. Methylene blue injected into the bladder will pass through the rectum; also if this solution is injected into the rectum it will pass in the bladder contents. This type of fistula will be demonstrated by proctoscopic examination but with greater difficulty than with the cystogram. By the proctoscope an

TABLE V.—POSTOPERATIVE RESULTS IN THIRTY-FOUR CASES OF VESICOSIGMOIDAL FISTULA

Case	Cure	Improvement	Recurrence	Remarks	Death
54223	+				
148184	+			Intermittent fæcal fistula for 1 year and 3 months	
79288	+		After 3 weeks	Four months after operation fistula remained; condition of bladder much improved; only pus in urine. Fistula healed in 3 years and 3 months	
24056	+			Slight bile colored drainage from wound gradually diminishing	
47407		+	+	Temporary closure for 8 weeks 4 months after operation. Persistent sinus in abdomen and cervix	
89618	+			Wound nearly stopped draining in 8 months	
48609		+		Gas continued. Cure was temporary	
25460	+				
4553	+				
245457	+			Gradually healing fistula	
2911181	+				
8463				Patient not heard from	
9513				Patient not heard from	
15387	+			Slight purulent drainage from wound on dismissal	
16609					After 5 days
194078	+				
233622	+			Slight seropurulent drainage from wound on dismissal	
156564	+			Only slight purulent discharge from wound on the twenty-eighth day	
273740	+			Purulent vaginal discharge. Also purulent discharge from abdominal sinus through which flatus had passed but no fæcal material	
76615	+				
68395	+			Fæcal fistula closed at operation 8 months later	
44697	+			Very slight drainage of wound on fifteenth day	
75616		+		Cure was only temporary and recurrence intermittent	After second operation from localized peritonitis.
113006	+			Fæcal fistula gradually improved	
140514	+				
104374				Small fæcal fistula one year later; little gas from bladder. Bladder irritability greatly lessened. Urinalysis negative	
52670	+				
186203	+		Nine months after first operation	First operation 2-28-17; second operation, removal of sigmoid, 10-26-18; cure	
291938	+			Gradually healing fæcal fistula. Slight seropurulent drainage from wound on dismissal	
291863					Five days after second operation from peritonitis
252703					Two days after second operation from peritonitis
287296		+	+	Condition improved subsequent to second operation, 12-3-19	From influenza, 1-20-20
7873	+				Four months later
262867				Case inoperable; permanent colostomy as palliative treatment	

inflammatory area, an inflammatory or benign stricture, or tumor in the presence of malignancy is more often observed. The odor of hydrogen sulphide of one specimen of catheterized urine may have arisen from gases produced in the intestines or from the transformation of contents in the bladder, but foreign to it. A bladder stone may form by the incrustation of lime about a foreign body, either from the fistula or from the urethra, such as the retained tip of a urethral catheter, and not only help to produce an acute and chronic diffuse cystitis, but lessen the possibilities of the fistula becoming more diminutive, thus augmenting the patient's discomfort.

In cases of extrophy of the bladder, or carcinoma of the bladder, the ureters may be successfully transplanted into the sigmoid and the patient apparently suffers no ill effects from urinary absorption, or from ascending ureteropyelonephritis. There may be a valvular action of a vesico-enteric fistula to keep any great amount of urine from entering the bowel. Negative urine in the small or large intestine apparently does not produce any untoward results, but decomposed urine, absorbed by intestinal mucous surfaces, may be a large factor in contributing to a fatal result.

In 11 of 21 urinalyses albumin, red blood cells, and pus averaged 1 on a scale of 4. Pus 3 to 4 was found in 8 instances. Hyaline casts were found once. The average specific gravity was 1,017. The urine was alkaline in these cases. Fæcal matter was discovered in three.

The diagnostic features of vesico-enteric fistulæ are bladder irritability, frequency, and dysuria, the elimination of gas, the final appearance of fæces or foreign substances in the urine, and the demonstration of the fistula. The presence of gas alone is not corroborative evidence unless it extends over a long period of time, since it may have been introduced by intravesical treatment or by instrumental examination.

The prognosis as to life depends principally on malignant or nonmalignant factors, peritonitis, metastatic foci of infection, and embolism, while prognosis as to cure depends on the nature, location, and extent of the infective process, and response shown by patient to proper medical and surgical treatment.

The patients' ages varied from the third to the seventh decades; 7 patients were between 20 and 30, 13 between 30 and 40, 8 between 40 and 50, 4 between 50 and 60, and 2 between 60 and 70.

OPERATIVE RESULTS

Twenty-three of the 34 patients (67.64 per cent) were cured by operation, the condition of 6 was improved, 6 had recurrences, and 2 of these had definite recurrences of symptoms as severe as they were originally. One of these patients was cured at the second operation, and the other improved but died of influenza. There were 4 postoperative deaths, a mortality of 11.76 per cent. In 11 cases (32.35 per cent) the vesical fistula was cured but a fæcal fistula remained. In 5 the drainage gradually stopped in from 15 days to 3 years and 3 months; in 1, cure was effected by a second operation; and in 2, the fistula gradually healed, no time limit being given (Table V).

After free drainage has been established, a proper radical dissection with the removal, in so far as is advisable, of all diseased tissue has been done; if the approximation is made with difficulty the sigmoid is closed over a large rectal tube. The results are gratifying even though there may be a gradually diminishing fæcal fistula for a relatively short time. Anything that can be done to improve the condition of these patients is worth while for they quite universally consider themselves of all beings the most miserable. They not only suffer from the nasty inconvenience of the fistula itself, but are greatly disturbed mentally over the new modes of eliminating dejecta.

All the patients with vesicosigmoidal fistulæ of tuberculous origin were cured; however, one of them had a mildly persistent abdominal and vaginal suppurating sinus. The greatest difficulty in the technique of these operations is the production of free drainage and the prevention of the establishment or re-establishment of a pus pocket in the operative field which is always considered infected. It is also difficult to prevent the reformation of adhesions between the bladder and the sigmoid whose tissues already have a lowered resistance, and are, together with the probable surrounding infection, conducive to a recurrence of the fistula (Table V).

CONCLUSIONS

1. Bladder mucosa may be normal in the presence of a vesicosigmoidal fistula.

2. Vesicosigmoidal fistulæ are far more commonly the result of infective or inflammatory causes than the result of malignancy; probably the most frequent cause is inflammatory disease of the uterine adnexa and next in frequency is sigmoidal diverticulitis.

3. Stricture or stenosis of the rectum or the sigmoid below the fistulous opening tends to increase the size of the fistula; it may also be one of the factors in the development of acquired diverticula of the sigmoid.

4. Mild cystitis or local areas of cystitis around a fistulous opening with intervening normal bladder mucosa are common symptoms.

5. The symptoms from vesicosigmoidal fistula existed in the majority of the 34 patients for nearly 1 year or more prior to operation. Two had symptoms for 10 years with only mild diffuse cystitis, while those with marked cystitis had had symptoms for about 1 year.

6. Ascending ureteropyelonephritis is not usually associated with vesicosigmoidal fistula.

7. Vesicosigmoidal fistulæ may heal spontaneously, if of infective or inflammatory origin.

8. Subsequent to an operation for vesicosigmoidal fistula due to a diverticulitis of the sigmoid, a new acquired diverticulum may form in which a diverticulitis may develop and produce a second vesicosigmoidal fistula. Such a predisposition to the development of acquired diverticula and their ultimate results may be overcome by a resection of the sigmoid of the Mikulicz type in which tissue of suspicious cancerous appearance is also removed.

9. A large rectal tube is a very useful aid in the closure of the sigmoid; it should be passed up beyond the closure and thus relieve an unnecessary strain that might be exerted upon the anastomosis.

10. Operative results show cure in 67.64 per cent of the patients and improvement in 17.64 per cent more. Contrary to the opinion frequently expressed, the operative results in the presence of local tuberculous infection were good.

11. In 32.35 per cent of the cases cured of vesical fistula a fæcal fistula remained which gradually healed within 15 days to 3 years and 3 months, and in only 2 of these cases was there a frank recurrence of all the symptoms which were cured or improved at the second operation.

12. The operative mortality is low (11.76 per cent).

13. Any reasonable attempt to improve the condition of these patients is advisable.

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ACIDOSIS IN OPERATIVE SURGERY

A Study of Its Occurrence During Operation and Its Treatment by Glucose and Gum Acacia Given Intravenously[1]

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IT has long been known to physiologists that there is an alteration of the chemical composition of the blood during states of activity, emotion, starvation, etc. The importance of this alteration has been recognized for several decades in internal medicine, but it is only recently that this factor has been given due consideration in surgery, for in surgery the interest was centered chiefly upon examination of the tissues removed. Pathology is in its rightful place, but physiology has lagged behind. It is of the greatest scientific value that all pathological specimens be carefully examined and studied, but it is equally as important that the living patient be as carefully examined and studied before and during the operation as the dead specimen is afterward. For this purpose the surgeon must call upon the biological laboratory. It is not sufficient to have a knowledge of physics and chemistry; one must have a knowledge of physical and chemical action in the living organism, and it is necessary that one should have a biological conception of the general metabolism of the body in health to find the cause and remedy when disorganized.

The physiologist and internist at times approach one another but rarely do the surgeon and physiologist come in contact; and yet how much greater is the need for collaboration between the surgeon and the physiologist, as the time may be all too short for the study of a condition suddenly confronting the surgeon at or immediately following an operation.

During the war the government of this country and of others, notably of Great Britain, called upon the physiologists to investigate and find, if possible, remedies for certain surgical problems. A committee was appointed by Great Britain as a "Special Investigation Committee on Surgical Shock and Allied Conditions." With such a step forward in making the laboratory and the operating room more intimately associated, it would seem that biological chemistry had come into its proper field, if the methods of examination could be shown to be simple, adequate, and of practical value.

The development of the theory of acidosis has been a gradual one and chiefly applied to diabetes or nephritis, but its importance in estimating a surgical risk, or its possible value during operation as an indicator of pending shock is only a recent growth, and it is with the object of ascertaining its value under such conditions that the present study has been made.

The word acidosis was first used by Naunyn to designate a condition in which certain acetone bodies were excreted in the urine of diabetic patients, but the term has gradually acquired a broader significance until as defined by Sellard, the essential feature in our conception of acidosis is a general impoverishment of the body in bases, or in substitutes which generally give rise to bases, so that the body as a whole shows some systemic abnormality.

The chemical composition of the blood in health is maintained at nearly constant level by the general metabolism of the body:

A. Energy is produced by:

1. Carbohydrates which are base forming foods;

2. Fats, which are base forming foods, but which need carbohydrates for their complete oxidation, otherwise they break down into oxybutyric or beta oxybutyric acid;

3. Proteids which are the acid forming foods of the body.

B. Elimination is accomplished by:

1. Kidney tubules excreting mineral acids, urea, nitrogen;

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2. Lungs, giving off carbon-dioxide and water vapor;
3. Sweat glands;
4. Intestinal tract.

If metabolism is faulty then there may be an accumulation of acid by-products in the body due either to excessive production or to defective elimination, or both together, and the condition of acidosis results.

If we stop for a moment to consider the regulation of respiration in health, the importance of this condition will become evident.

The work in 1905 of Haldane and Priestley on "The Regulation of Lung Ventilation" marked an epoch in our knowledge of the factors controlling respiration and has led to the so-called "New Physiology," and has aroused interest in the study of the chemical constituents of the blood. These investigators found that lung ventilation is due to the response of the respiratory center to changes in carbon dioxide tension of alveolar air and arterial blood, and not to stimulation of the vagi nerves. For each individual at rest, and under normal atmospheric conditions, the normal alveolar carbon dioxide pressure appears to be an extraordinarily sharply defined physiological constant, but a slight rise or fall in the alveolar carbon dioxide pressure causes a great increase or diminution in the lung ventilation. As carbon dioxide in watery solution acts as a weak acid, by virtue of the hydrogen-ion, and dissociates into

$$CO_2+H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H+HCO_2$$
$$\uparrow\downarrow$$
$$H+CO_3$$

it has been thought that the hydrogen-ion of the blood which is practically constant (while the carbon dioxide fluctuates), is the respiratory factor, but later investigators have come to the conclusion that the carbon dioxide in the blood has an influence not due to hydrogen-ions but due possibly to a specific effect of the undissociated carbon dioxide, either directly stimulating the respiratory center itself, or in increasing its irritability to the hydrogen-ions.

The hæmoglobin of the blood carries oxygen from the lungs to the tissue cells of the body, and it is from within these tissue cells that carbon dioxide is produced, the exchange of these two gases constituting the internal cellular respiration.

The tension of arterial blood leaving the lungs is 40 millimeters mercury and in the alveoli of the lungs is 80 millimeters mercury. It is because of the low tension in the arterial blood and the higher partial pressure of carbon dioxide in and around the capillaries that gas is taken up by the bicarbonates in the blood to be given off in the alveoli of the lungs. The bicarbonates of the blood, the so-called "buffer substances" of the blood are then the carriers of the acid by-products of metabolism to the alveoli of the lungs and constitute the alkali reserve of the body. If the bicarbonates are present in the blood in large amount the combining power of the blood, that is the ability of the bicarbonates to unite with carbon dioxide, is high; hence the carbon dioxide tension in the blood is low, but if there is a diminution of the bicarbonates the carbon dioxide will accumulate in the tissues and the increased carbon dioxide tension in the blood will stimulate the respiratory center to increase respiration. If alveolar ventilation is not then obtained a condition of intracellular acidosis results with serious disturbance to internal respiration.

We may liken lung ventilation to an omnibus line with limited seating capacity. If the busses are full the crowds in the streets stimulate the starters to telephone the central office to increase the number and speed of the busses. If all available omnibuses are in circulation and the crowds still increasing, the people must find other ways to return home or the congestion will block the road and overflow into the side streets.

Blood bicarbonate is then the criterion of the acid base balance of the body and its percentage in the blood is a most important factor in surgery. During operation, owing to the increase in acid metabolism and also to the fact that anæsthesia affects the liver which is the regulator of acid by-products, there is a considerable drop in the alkali reserve, but as long as there are fixed bases in the blood the elimination of carbon dioxide

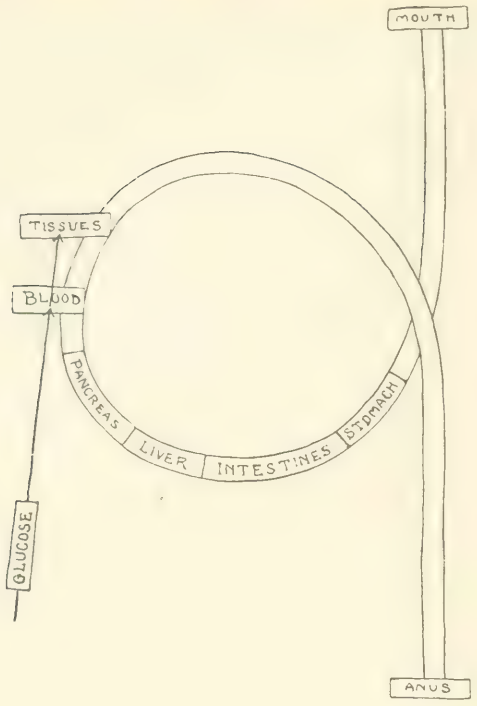

Fig. 1.

will continue. If the alkali reserve is high to begin with the drop may not be great enough to cause a severe acidosis. But the "more marked the existent acidosis to begin with the more sensitive is the patient to operative procedures and the more likely is he to be let down by them into a region of danger."

Lusk proved experimentally that an individual can go without food for a number of days without producing an acidosis, as nature has time to regulate metabolism by drawing upon the stored bases in the body. But in hæmorrhage and shock, in the presence of a lowered blood volume with either actual loss of blood from the body or with stagnation of blood in the capillaries, the fall in alkali reserve in a very short period of time may be so great that the tissues cannot adjust themselves to the altered metabolism and so fail to maintain respiration.

The question arises as to where the loss in bicarbonates occurs. Several ways are possible; such as (1) in excessive pulmonary ventilation; (2) in acetone bodies in the urine; (3) in organic acids other than acetone bodies; (4) in the tissue cells of the body.

Henderson and Haggard believe that the loss occurs in excessive pulmonary ventilation during anæsthesia and that this loss can be prevented by administering 7 per cent carbon dioxide air. Reimann and Bloom, however, have shown that blood acetone bodies account for from 20 to 100 per cent of the lost bicarbonates (on an average 60 per cent), and it is possible that organic acids other than acetone bodies account for an additional amount. Caldwell and Cleveland of the Presbyterian Hospital found acetone present in the urine in 72 per cent of cases following operation and diacetic acid in 56 per cent. Morris, in Deaver's clinic, reported 61 per cent acetonuria in postoperative cases.

It would seem reasonable to conclude that in mild cases without shock or hæmorrhage the fall occurs in the first three ways. In hæmorrhage the actual loss of blood from the body would account for an additional loss of bicarbonates. In shock, however, we must look for another cause, for in shock there is the greatest fall in the alkali reserve.

Cannon showed by his work on soldiers suffering from shock that when blood pressures were equally reduced, hæmorrhage alone was not attended by as great a reduction in alkali reserve as was found in shock, and further that the urine in shock cases did not show diacetic acid. The acidosis of shock cases then must, according to this evidence, be due to some alteration of the blood other than the production of acetone bodies. With the development of shock there is an actual loss to the circulation of a large volume of blood, and recent investigation has proved that this blood lies not in the large veins of the body but is stagnant in the capillaries. It is here and in the tissue cells that the carbonates of the blood remain and consequently are out of the circulating blood. For this reason the carbonates are lost to respiration in the tissues.

The increase of sugar in the blood during hæmorrhage and shock has been the subject of investigation for a number of years. Shenck found experimentally that, when hæmorrhage was produced after ligation of the liver vessels,

there was an actual decrease in blood sugar which fact pointed to the liver as the source of the increased supply. Tatum states there appears to be a reciprocal relationship between the rise in blood sugar and the fall in alkali reserve in these conditions. This would seem to imply an effort on the part of nature to supply sugar as the agent to offset the destructive effect of a loss in blood to the tissues of the body. Because of this fact and because of its food value glucose was chosen for the following experiments.

A large percentage of the glucose normally present in the plasma of the blood (0.08 per cent) is not combined but circulates free in the blood and is assimilated in this form without further change. Glucose has a nutritive value of 4 calories per gram, is nontoxic, diuretic, is readily obtained, and easily prepared and kept in stock solution. It is not stored in the tissues as is salt when given in hypertonic solution; nor is there a danger to other tissues such as there is in giving large doses of bicarbonate intravenously. Doyon and Duport, in 1901, and Blumenthal, in 1906, discovered that the rate of utilization of sugar by the tissues depended upon the velocity of injection. Woodyatt and his coworkers have proved by actual experimentation that an individual will absorb each hour 0.8 of a gram of glucose for each kilogram of body weight without glucosuria, and that the rate can be maintained for hours if desired. Thus a woman weighing 65 kilograms (approximately 150 pounds) would receive 52 grams or 208 calories per hour given intravenously. If given by mouth, subcutaneously, or put into the bowel, Woodyatt says glucose does not pass into the blood faster than at an approximate rate of 1.8 grams an hour, which is not sufficient to permit much glucose to escape utilization. The nearest possible approach to a scientifically accurate method of sugar tolerance measurement must be by direct vascular administration. Each tissue then receives its share in proportion to its vascularity, and absorbtion plays no part, as the liver is not necessary for the utilization of sugar in the blood (Fig. 1). If the resting requirement of the patient (of 125 to 150 pounds) is 1,800 to 2,000 calories per day, she will receive in 24 hours 4,992 calories, or more than double the actual need at rest and sufficient for the loss incurred during heaviest work. In an operation of 2 to 3 hours' duration she would receive from 400 to 600 calories, or from $\frac{1}{6}$ to $\frac{1}{3}$ of the total need for metabolism in 24 hours. Glucose is not only a food and source of energy, but is a stimulant to tissue cells of the body, raising the whole metabolism and thus saving the liver function and restoring glycogen reserves. It not only increases the power of involuntary muscle fiber, but has, according to Lusk, a specific effect on the heart muscle itself.

If glucose is to be injected for several hours, and the rate of tolerance has been exceeded, an examination of the urine one-half hour after the injection has been made will show sugar present in the urine. The effect of sugar, if the rate has been exceeded, is a marked diuresis, and sufficient water should be given to counterbalance the loss of body fluid. If the rate of absorption is adhered to, both the danger of dehydration of the tissues on the one hand and of overburdening the heart with too large a volume of fluid, will be avoided.

The solution of glucose used in our experiments was made from chemically pure anhydrous dextrose and distilled water. A 20 per cent solution was considered as sufficiently hypertonic to avoid hæmolysis and flasks of 250 and 300 cubic centimeters were sterilized in the autoclave and then kept in an ice box near the operating room for emergency use. Injection is made in the vein of the forearm during the operation and the rate of flow regulated by a stop cock on the tube. The rate is easily calculated as follows: If the subject weighs 65 kilograms, the rate is 0.8 of a gram per kilogram and the solution 20 per cent. Multiply 0.8 by 65 by 5 (*i.e.* 20 per cent) equals 260 cubic centimeters per hour. Divide 260 cubic centimeters by 60 (minutes) equals 4.3 cubic centimeters per minute or approximately one flask an hour to the average patient; more of course, if the weight is greater.

Woodyatt has devised a volumetric electric pump by means of which the rate and amount can be accurately gauged, but while its

desirability is great for hospital work, the cost is considerable and any method such as is used for arsphenamine injection is satisfactory. The solution should be given at 105° F. and if it is poured into the container at 115° F. and the tubing placed between two hot water bags, the heat will be maintained throughout the administration. An infusion thermometer in the lower end of the tubing ensures an accurate temperature.

While glucose has been used in this series of cases to combat the acidosis incident to operation, it has also been given with most beneficial results in cases of peritonitis and in exhaustive postoperative vomiting to maintain nutrition. There is in such cases a great loss of fluid from the body in addition to what the patient has lost during operation and metabolism fails because nature cannot utilize the stored protein and fat in the body without water. In such cases an isotonic (5 per cent) or hypotonic (2 per cent) solution may be preferable for a time to restore body fluids, but the blood pressure should be watched that the heart be not overburdened with a large volume of water suddenly injected into the veins. Generally speaking the hypertonic solution (15 to 25 per cent) is preferable intravenously and the Murphy drip 5 per cent glucose given by rectum or saline subcutaneously until the patient is able to take fluids by mouth. It is in the cases of extreme vomiting, of acidosis, either postoperative or in pregnancy, peritonitis and postoperative anuria or uræmia, where, as Crile says, blood transfusion has no value, that glucose intravenously furnishes the means to combat the condition. Litchfield used glucose intravenously in pneumonia with excellent results and found that it has a beneficial action that seems to last beyond the time of injection, due, according to Woodyatt, to the re-establishment of the oxygen supply caused by improvement of the blood flow through the part and the resultant diminution of asphyxial acid accumulation.

So far glucose has been spoken of only in relation to a fall in the alkali reserve occurring in an operation without an appreciable degree of shock. We approach now a condition in which the most marked changes may occur in a short period of time producing, with or without excessive energy transformation, a condition of intracellular acidosis and consequent disturbance or cessation of the interchange of gases within the cells themselves and resulting in interference with intracellular respiration, which is life itself. The histological changes in the cells of the brain, liver, and adrenals appear within a few hours and indicate the profound alteration produced by this state.

As Cannon has shown by his investigation on cases of shock in the trenches, the fall in alkali reserve in shock, unaccompanied by loss of blood from hæmorrhage, goes hand in hand with the fall in blood pressure. If blood pressure can be maintained or the fall diminished, there must be a saving of the alkali reserve, and to this end gum acacia was added to the solution of glucose in one of the series of cases at the Woman's Hospital.

The report of Bayliss, of the Special Investigation Committee, on intravenous injection states that with simple saline solution of any kind the blood pressure falls to a low level by the end of an hour or so and the process continues until death. A secondary fall about an hour after injection sometimes occurs in the case of gum solutions, but it is not so low as that with saline at the same period and the effect is soon overcome.

Bayliss also states that no solution containing salts alone is of much value, as the rise in blood pressure is not permanent. An isotonic salt solution is deleterious, for, owing to the diminution of the colloid concentration in the blood and because of diminished peripheral resistance in the arterioles, the salt solution escapes into the tissues and attracts the water from the blood stream after it. Hypertonic salt solution has same effect after a short initial rise in blood pressure.

Sodium bicarbonate given intravenously, which theoretically should be beneficial, has proved clinically dangerous, as Van Slyke has shown, because of the excess bicarbonate passing into the tissues. To ensure a satisfactory rise of arterial pressure without necessity of introducing a large volume, the presence of a colloid with an osmotic pressure comparable to that of the blood must be used.

Gum acacia (arabinose) is a gum colloid and has been used for shock cases (in 5 to 7 per cent solution) with beneficial results in raising blood pressure. It is a known fact that crystalloids, to which class glucose belongs, when in the blood stream, will attract water from the tissues, and it has been proved, experimentally, by Erlanger and Gasser that this is the effect when glucose is injected into animals and that gum acacia will maintain the expanded blood volume.

Before endeavoring to offset the fall in alkali reserve during operation, it seemed advisable to find the normal variation in women of the carbon dioxide combining power of the blood as the percentages given by Van Slyke (52 to 78 per cent for 100 cubic centimeters of blood plasma) were in men. For this purpose 175 patients were examined on entrance to the Woman's Hospital. The examinations were made by technicians from the Rockefeller Institute and the Van Slyke method was used in each case. The bicarbonate content of the arterial blood plasma is the most accurate measure of the alkali reserve of the body fluids as a whole. On account of the technical difficulty of taking arterial blood for examination, the determination was made from venous blood with only a difference of a fraction of 1 per cent, as Van Slyke has shown. In the usual way for making a Wassermann, 10 cubic centimeters of blood is drawn into a test tube containing a few grains of potassium bicarbonate to prevent coagulation. The blood is centrifuged and the determination of carbon dioxide capacity is made by blowing into the blood plasma carbon dioxide to the saturation point; in other words, it is the determination of the number of cubic centimeters of carbon dioxide gas which 100 cubic centimeters of blood plasma will take up. The result is expressed in volumes per cent of carbon dioxide. The procedure is relatively simple and requires only 4 to 5 minutes. The results obtained were as follows:

Percentage	Cases	Total
45.8 to 50	6	..
50.0 to 55	19	25
55.0 to 60	60	
60.0 to 65	61	
65.0 to 69.9	20	150
Total		175

Eighty-five per cent of the patients had a carbon dioxide combining power of the blood between 55 and 70 per cent.

Of the 6 cases between 45.8 and 50 per cent, 4 cases were of inoperable carcinoma of the cervix with extensive involvement; 1 was a patient who had had severe hæmorrhage and had a hæmoglobin of 23 per cent. The 19 cases between 50 and 55 per cent included 2 cases of pregnancy, 1 with pulmonary tuberculosis; 2 of subacute appendicitis; 3 with menorrhagia following abortion. No one of these cases would have been considered clinically to have been more than a fair risk. The other cases were on other divisions and the history is not known.

The carbon dioxide combining power of the blood was then ascertained for 50 patients under 50 years of age, with a temperature not above 99°, pulse below 90, and hæmoglobin 85 per cent, or above, with the result as follows:

	Woman's Hospital, New York	Van Slyke's Figures for Men
Lowest	55.2 per cent	52 per cent
Highest	68.9 per cent	78 per cent

Forty of the 50 patients had a combining power of 60 per cent, or above.

It would seem therefore that the upper limit in women is about 8 points lower than in men (52 to 78), which corresponds to what Van Slyke has estimated, but that the lower limit in women is not so low as in men. As 50 is the figure Van Slyke has put below which an acidosis probably exists, and which seems to hold true clinically for women, this shorter range may mean that acidosis occurs more frequently in women, for we know that acetone bodies are more often found in the urine of women after operation than in men.

The shorter range between the normal limits in women is the reason why acetone bodies are more frequent in pre- and post-operative urine. If the upper limit of the carbon dioxide combining power is lower, the range is shorter, and the danger line sooner reached. In 10 of Cannon's series of shock cases operated upon in the trenches, the carbon dioxide capacity before operation was 40 per cent or less and in two of the cases the capacity fell after operation to 27 and 28 per cent. Cannon states that blood taken

COMPARISON OF VAN SLYKE AND WOMAN'S HOSPITAL FIGURES

	Van Slyke's Figures for Men	Woman's Hospital Figures
Limit of bicarbonate reserve in normal resting adult.....	53 to 80 per cent Range 27	55 to 70 per cent Range 15
Limit of bicarbonate reserve in adult with no pronounced symptoms.....	40 to 53 per cent	50 to 55 per cent
Limit of bicarbonate reserve in adult with moderate to severe acidosis—symptoms may be apparent.....	30 to 40 per cent	45 to 50 per cent
Limit of bicarbonate reserve in adult with severe acidosis—symptoms of acid intoxication	below 30 per cent	below 45 per cent

from the heart at the moment of death from shock has a carbon dioxide capacity between 20 and 24 per cent. In the series of cases operated upon in the Woman's Hospital, the condition was critical when the alkali reserve reached 42 per cent or 44 per cent. Blood taken from two patients shortly before death showed 27 and 28 per cent. This would seem to indicate that in women not only is the carbon dioxide combining power of the blood plasma not as high as in men but that a critical state is reached earlier in the scale than in men.

Examination of the blood taken at the end of operation was made in 100 cases to ascertain the fall in alkali reserve incident to the operation. The anæsthetic given was nitrous oxide gas and ether, by the closed method. Only one bag of gas was used and the amount of ether varied from 2 to 17½ ounces. The duration of anæsthesia varied from 30 minutes to 3 hours 15 minutes. The operations were gynecological and included plastic and abdominal work and were done by ten different operators. One hundred cases examined both before and at the end of operation showed a fall in alkali reserve varying from 0.7 per cent to 22.2 per cent.

Austin and Jonas reported a fall in alkali reserve during operation as follows: lowest 4 and highest 18 per cent; Reimann and Bloom, lowest 5, highest 15; Morris from Deaver's clinic, lowest 0.4, highest 22.7; Cannon on cases operated upon in shock, lowest 6, highest 19 per cent. Clinically when the fall reaches 15 or more points, the patient shows symptoms of beginning shock as evidenced by falling blood pressure, rapid pulse, and increased respiration.

One hundred cases examined both before and at the end of operation showed a fall in alkali reserve from 0.7 to 22.2 per cent. In 14 of the cases the alkali reserve fell 15 or more points. The incidence of acute acidosis during operation is 14 per cent.

To ascertain the effect of glucose feeding on vomiting, 20 patients were given glucose solutions (20 per cent) intravenously, the amount varying from 24 to 72 grams according to body weight and duration of the operations, which lasted from 1 to 3 hours (anæsthesia). The cases were the most critical of the series including 2 Wertheim, 4 Mayo, 2 enteroceles, 1 resection of bowel for carcinoma of sigmoid, 3 cases of hæmorrhage, 3 large fibroids, and 1 large, densely adherent, intraligamentous cyst. The result was that vomiting was entirely absent in 16 cases, and nearly so in the other 4 cases—the amount was only 1 to 2 ounces and occurred not more than 4 times in any case.

During the same period of time 10 cases, less critical in type, were operated upon by the same two operators with anæsthesia varying from 58 minutes to 2 hours, 15 minutes in duration. Only 2 cases had a correspondingly slight amount of vomiting while the other 8 cases vomited from 24 to 59 hours.

A comparison was then made between the fall in alkali reserve, blood pressure, pulse pressure, pulse rate and respiration in 20 cases operated upon without appreciable shock. The duration of operation varied from 51 minutes to 3 hours, 6 minutes. The amount of ether used was from 3 to 17 ounces. The fall in blood pressure is a more reliable guide during operation to pending shock than is the alteration in pulse rate and respiration, inasmuch as it is the cause upon which that alteration depends. The comparison showed a fall in alkali reserve in the 20 cases of 0.7 to 11.7 per cent; in blood pressure 4 to 50 points; in pulse pressure, 4 to 20 points in 6 cases, 5 to 40 points in 10 cases, remaining the same in 4 cases; the pulse rate remained the same in 1 case, increased 4

to 40 beats in 14 cases, fell 8 to 26 beats in 5 cases; respiration remained the same in 10 cases, was increased 2 to 10 in 9 cases, and lessened 4 in 1 case. The fall in blood pressure bears a close relation to the fall in alkali reserve. The change in pulse rate and respiration is not constant.

The next and final step in the study was to see if blood pressure could be maintained during hæmorrhage or shock. The reports from the British Special Investigation Committee on Surgical Shock, on intravenous injections to replace blood and particularly upon the use of intravenous injection of gum acacia in surgical shock, led to the following procedures.

Bayliss, and later Drummond and Taylor, used a 5 to 6 per cent solution of gum acacia in salt solution of different strength. As I believed that beneficial results had been obtained by glucose solution I added 6 per cent gum acacia to the glucose and gave the combined solution. I found later that Erlanger and Gasser had used this same solution, but with a higher percentage of glucose (30 per cent). Salt or bicarbonate of soda was not added to the solution for the reason, as Erlanger says, that the fluid is introduced so slowly that the water attracted to the blood stream by the crystalloid sugar brings salts with it. Absolutely no harmful result has occurred to the patients in any way. Three of the patients who had been given glucose intravenously in the wards for postoperative vomiting, had chills, due to the fact that the solution was injected too rapidly. There were no other complications. No patient who has been given during operation intravenous injections of glucose or gum glucose solution and the rate of injection has been directly under observation, has had chills.

Patients were given 6 per cent gum acacia and 20 per cent glucose at subtolerant rate just as described previously in giving the glucose solution, because they were low in carbon dioxide combining power, were frankly bad risks, or had had a hæmorrhage. In 2 cases of 250 and 255 blood pressure, respectively, where the solution was not given until the blood pressure had fallen 100 points, the pressure then fell only 10 and 15 points lower on administering the solution, and 1 hour after operation was above the point where it was when the solution was begun. Two cases in which the solution was started late, after severe hæmorrhage and the blood pressure had dropped 30 to 45 points, showed 1 hour later, 10 and 12 points above the blood pressure findings at the beginning of operation. One case of 3 hour anæsthesia, with large, densely adherent cyst of the pancreas, dropped 12 points. The other 32 cases were from 2 to 30 points higher at the end of operation, and only 3 of the above cases showed a fall in alkali reserve, of 15 points.

Of 40 cases which were given gum glucose after hæmorrhage or in prolonged operations, the blood pressure dropped only 1 to 15 points in 8 cases, and in 32 cases the blood pressure was the same or from 2 to 30 points higher at the end of operation.

Six per cent gum acacia in 20 per cent glucose solution will help to maintain blood pressure if given throughout an operation.

TECHNIQUE OF PREPARATION OF GUM GLUCOSE SOLUTION

(From the Laboratory of the Woman's Hospital)

6 per cent Gum arabic
20 per cent Dextrose
0.9 per cent Sodium chloride

Procure gum arabic, grade A. Kordofan or Egyptian, in powdered form, which will go into solution more readily than the crystalline form. If the gum is in lumps, considerable time will be saved if it is ground before attempting to dissolve it.

Chemically pure anhydrous dextrose is used for the solution. There are several varieties of "pure" dextrose which are much cheaper but greater care must be exercised to remove impurities or a heavy deposit will remain after the final sterilization.

For 1 liter of gum glucose solution weigh out 250 grams chemically pure anhydrous dextrose and 60 grams gum arabic. Suspend the gum in 300 cubic centimeters normal salt solution, stirring until most of the gum has dissolved and then let stand in a refrigerator over night completely to dissolve the residue. The following day dissolve the 250 grams of dextrose in sufficient warm salt solution to make a total volume of 625 cubic centimeters and filter through cotton. The excess quantity of solution is necessary to counteract the loss due to the filtration.

Add 500 cubic centimeters of the dextrose solution to the gum solution, and mix. Then make up to 1 liter with normal salt solution. Place in a boiling water bath for ½ hour, stirring frequently. This heating will dissolve the gum completely and will also precipitate out impurities in both gum and dextrose.

Again make up to 1 liter with normal salt solution. Titrate the reaction and neutralize with 10 per cent solution sodium carbonate, (approximately 15 cubic centimeters of 10 per cent sodium carbonate solution will be required per liter). This must be done since the solution has been found to be quite acid (arabic acid).

Autoclave for 15 minutes, at 15 pounds pressure which will precipitate a quantity of solid matter. Care should be observed to have the solution subjected to the same degree of heat as in the final sterilization or a clear solution cannot be obtained.

Filter through cotton and then through a Buchner filter, using two layers of linen and two of hard filter paper, Whatman No. 50, arranged alternately and moistened on the filter with saline solution (in layering start with linen). The linen serves as a support for the paper which otherwise would be sucked through the holes of the funnel under the pressure applied.

Divide into 250 and 300 cubic centimeter lots, which are convenient amounts, and pour into clean sterilized Erlenmeyer flasks and autoclave for 15 minutes under 15 pounds pressure. If the solution is clear and free from sediment it is now ready for use. If the gum glucose solution is not to be given immediately, the flasks must be placed in a refrigerator where the solution will keep for a long time ready for emergency use.

Before closing mention should be made of other tests for acidosis, and of the prophylaxis, and the postoperative treatment of this condition.

While it is believed that Van Slyke's test for the alkali reserve gives the simplest and most accurate means of ascertaining the acid base balance of the body, still an effort should be made, especially when the carbon dioxide combining power is low, to study the patient from all angles and treat him so that he will be able to withstand a surgical operation. To this end the patient's metabolism and eliminative processes should be determined and an effort made to limit the production of acid by-products and to increase their elimination.

Acid by-products result from a deficient supply of carbohydrates or an excess of protein which gives rise to acid-forming elements and thereby depletes the stored bases of the body. The diet before operation should consist chiefly of starchy foods together with vegetables and the citric fruits, which are changed to carbonates in the stomach. Shigenoba has shown by experiments that the kind of food has a marked influence upon the acid-base equilibrium of the organism. Though the carbon dioxide capacity of the plasma is 61 to 64 in green diet, this value is reduced to 48 to 53 on protein diet—the hydrogen-ion concentration of the blood remains constant with both kinds of diet. The postoperative diet should be of the same character,—fruit juices or fruit albumen, cereals (not oatmeal), citric fruits, honey, sugar, starchy foods, and vegetables. As starvation is a cause of acidosis, food should be given up to a short time before operation and feeding begun early after the operation. Bicarbonate of soda is of undoubted value in raising the alkali reserve if given for several days preceding the operation.

As the alkalinity of the blood is maintained for the most part by the tubules of the kidney, it is of great importance to know their ability to eliminate acid by-products. In health the effete nitrogen of the proteid molecule is used to make ammonia salts and combines to form urea, but with an excess of acids the ammonia is used to neutralize them and consequently escapes conversion into urea. In health the ammonia nitrogen represents about 2 to 7 per cent of the total nitrogen, but in acidosis it is usually over 10 per cent and may in severe acidosis rise to 20 or 30 per cent. It is not until all the ammonia is combined that the acetone bodies appear in the urine. The importance of examining then for acetone bodies is evident especially in women. Caldwell found acetone bodies in 23 per cent of his cases before operation. The soda bicarbonate tolerance test of Sellard is a valuable aid in estimating the amount of alkali necessary to render acid urine alkaline. In health 10 to 15 grams of bicarbonate of soda will make the urine alkaline in 8 hours but with an excess of acid in the urine the amount is greatly increased and an estimate may thus be made of the total acidity by the amount of soda bicarbonate required. The phenolphthalein test, while it shows a wide variation, points to a condition of acidosis when the total output of urine in 2 hours is 30 per cent or less.

The respiratory capacity of the lungs may be further studied by estimating the carbon dioxide tension in the alveolar air and by the simple test of Yandell Henderson for acidosis, *viz.*: the ability to hold the breath for the normal period of forty seconds.

The intestinal tract and the sweat glands of the body should be considered as important

factors not only in carrying off waste products but for the loss of fluid to the body.

Purging shortly before operation and post-operative vomiting remove a large amount of water from the tissues thus predisposing to acidosis. Patients in the calorimeter eliminate water through skin and lungs (DuBois) at a rate which varies between ½ and 1 liter a day. In active exercise or nervous excitement the amount is greatly increased. Benedict quotes the case of a foot ball player who lost 14 pounds in a game 1 hour and 10 minutes long; ¼ pound due to oxidation of solids, 13¾ pounds water lost.

The patient who at the end of operation has saturated the coverings above and below with perspiration greatly needs the addition of fluid which may readily be placed in the bowel (1–1½ quarts) while the patient is unconscious to offset this loss of fluid to the tissues, and a further addition of fluid intravenously, subcutaneously, or by Murphy drip, as the need may be, is an aid of metabolism.

SUMMARY

1. Acidosis is a term used to signify an impoverishment of the body in bases.

2. The alkali reserve (bicarbonates of the blood) is the criterion of the acid-base balance of the body.

3. The determination of the alkali reserve (*i.e.* the number of cubic centimeters of carbon dioxide gas which 100 cubic centimeters of blood plasma will take up) is readily made by Van Slyke's method.

4. A high carbon dioxide combining power of the blood is of the greatest importance for the maintenance of lung ventilation during operation.

5. The range of the carbon dioxide combining power of the blood in women (150 cases) is 55.2 cubic centimeters to 69.9 cubic centimeters per 100 cubic centimeters of the blood plasma or about 8 points lower than Van Slyke found for men.

6. As the range is shorter in women the danger line is sooner reached which accounts for the greater frequency of acidosis following operations in women than in men.

7. The fall in alkali reserve during operation depends not only upon the anæsthetic and the duration of the operation but upon the nature of the operation and the occurrence of hæmorrhage and shock.

8. The fall in alkali reserve bears a close relation to the fall in blood pressure and pulse pressure. If the fall in blood pressure is prevented, there is a saving in alkali reserve.

9. A solution of glucose given intravenously during an operation at the rate of 0.8 gram of glucose for every kilogram of body weight each hour of the operation will lessen the acidosis incident to operation by promoting metabolism, prevent or diminish the vomiting, and promote diuresis.

10. Glucose will appear in the urine in one-half hour if the rate has been exceeded.

11. A solution of gum acacia (6 per cent) in glucose (20 per cent) if given at a subtolerant rate the entire time of operation is an aid to the maintenance of blood pressure.

12. Carbohydrate feeding before and after the operation together with the use of bicarbonate of soda will do much to prevent or lessen acidosis.

CONCLUSION

Every well equipped hospital laboratory should have a paid physiologist who could devote his time to the study of problems on the living tissue as the pathologist does on the specimens removed. The study should cover organic regulation as a whole and not individual cells or tissues. Biology would not then be divided into its branches but would comprise a study not only of anatomy and pathology but physiology and biological pharmacology as well. The problems should be of practical import, of like value to patient and surgeon. The student should have made known to him the facts of general metabolism and their relation and importance to surgery. This information should not be isolated and scattered but grouped and given as a part of student work preparatory to surgical training.

As we bring a more scientific spirit to surgery we approach to what Haldane terms the humane physiology, for it is only by a study of life that we know the living and can give the sympathy and understanding which is as much a duty as is the technical skill for the true surgeon.

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SUPERFŒTATION OR SUPERFECUNDATION?[1]

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IT was the writer's good fortune to receive an interesting specimen of a double (twin?) pregnancy in which the two fœtus were of such greatly different sizes and stages of development as to lead to the conclusion that the specimen represented an instance of superfœtation. As there has been considerable controversy on the subject and as many arguments have been presented, pro and con, with numerous cases to uphold the various arguments, I was interested in looking up the literature in studying my case.

According to some writers superfœtation is an impossibility, and all such reported cases, according to their view, are cases of superfecundation in which the smaller fœtus either died early or was markedly retarded in its development. Such views are expressed by Schultz, Godlewski, Kuntz, and others.

At present, superfœtation means a second impregnation of a female already pregnant.

Superfecundation is the impregnation of two or more ova of the same stage of development by coition at different times.

Superfecundation according to Mertens means a second impregnation of one already pregnant, but before the decidual membrane is formed. By superfœtation he means a second impregnation after the decidual membrane has been formed.

According to Marshall superfœtation is a condition in which fœtus of different ages may be present in the same uterus. There is no mention of the necessity of a second coition. According to him if ovulation takes place during pregnancy and if, owing to the occurrence of coition, the ovum becomes fertilized, then the phenomenon of superfœtation takes place. The ova belong to different periods of ovulation.

According to King superfecundation consists of the fertilization by successive matings of ova belonging to the same period of ovulation. Superfœtation is due to the fertilization of ova of different periods of ovulation followed by copulation occurring during pregnancy, which leads to the simultaneous development of two sets of ova. This involves a second coitus and a second ovulation.

Sumner, on the other hand, believes that superfœtation may be the result of a second coitus, but not necessarily so. In mice the sperm may be retained in the female for a

[1] From the Daniel Baugh Institute of Anatomy.

long time and still be functional and produce superfœtation.

Harmon considers superfœtation as a condition in which the uterus contains fœtus of different degrees of development, due to either a second coitus or not.

In analyzing the foregoing, there is a difference of opinion as to whether a second coitus is necessary or not. If this is necessary in all cases, then the chances of a superfœtation are rather limited. On the other hand, the cases of a second litter of young (in some animals) following in a short time a first litter, without a second copulation, would be impossible of explanation except through the longevity of the sperm in the genital tract of the female. Here only one intercourse prevailed, so that the persistence of sperm must be considered. How long sperm will live in the female genital tract under normal conditions is not known, but in lower animals no doubt it lives for quite a time. In the hen it is said that the sperm lives for 5 weeks in the genital tract, so that several weeks may pass and ova may still be fertile after having been tread only once by the male. In mice a second litter is occasionally born without a second coitus. The sperm of man may be kept alive for several weeks upon a warm stage, under proper conditions, and Duehrssen and Zweifel found living sperm in the oviduct removed from a woman, in which instance it was positively stated that there had been no cohabitation for 4 weeks. If this can occur in a human female, it seems possible that an ovum of a successive ovulation period might readily be fertilized, producing superfœtation.

Bearing this in mind it would be well to leave the question of a second coitus open, for if the sperm would live 4 weeks, it might live longer. Of course, we know nothing of its ability to fertilize an ovum after such a time, nor can we positively say that it will not fertilize an ovum after that time. Another factor to be borne in mind is the viability of the ovum. It is generally believed that the ovum soon loses its power of chemotaxis, so that if not fertilized by the end of 7 days it undergoes degeneration and is not capable of being fertilized and of developing. Some are inclined to believe that the egg may live much longer and if it would live from one ovulation period to another, then its fertilization would be a superfecundation with a difference in the developmental stages of the two fœtus. It is no doubt true that the ovum lives only about 7 days. We might, therefore, modify Block's views and define the two terms as follows:

Superfecundation is that condition in which two or more ova belonging to or originating at the same ovulation period are fertilized by sperm from coitus practiced at different times by the same or another male. The ova may originate from one or both ovaries, but in the latter case the ovulation must be practically simultaneous.

Superfœtation is the fertilization of two or more ova that belong to or originate at different ovular periods by sperm from coitus at the same or different times, by the same or another male. This imposes a pregnancy superimposed upon another by the fertilization of an ovum of a later date, by the same or another male. Both fœtus develop in the same uterine cavity, but are of noticeably different ages. The writer would desire to insist upon the fact that one coitus may suffice for the double purpose.

Having established an understanding as to the interpretation of the term superfœtation, it will next be necessary to consider the evidence for and against its occurrence. This condition has been the subject of discussion and controversy from earliest times as we find it discussed by Hippocrates, Aristotle, Pliny, Schenck, Schacher, La-Chausse, and others. As superfecundation is so closely related to superfœtation, it will be of interest to consider that phase first and then to present the reasons for and against superfœtation.

According to Mertens there are a number of factors underlying the condition of superfecundation: (1) An ovum may have two yolks; (2) graafian follicles may have two ova; (3) in the same ova two or more follicles may mature at same time; (4) both ovaries may ovulate at same time, giving rise to two or more ova. In the first case it seems impossible that both yolks would not be fertilized at the same time so that superfecundation would result.

In the second and third instances superfecundation might readily occur. The ova might be fertilized simultaneously and show analogous developmental stages, yet again successive fertilizations may occur, tending to give different developmental stages of the various fœtus.

In the fourth instance there is the greatest possibility of superfecundation. In this case the sperm may go up only one oviduct and this is most probably if the uterus is double. Although this is rare in human beings it has been proven, when due to intercourse with different individuals, especially of different races. Again, if there be a difference in the size and apparent fertilization of the two products of conception, they must always be considered instances of superfecundation if there has been but one coitus.

The condition of superfecundation is quite common in lower animals and is frequently met with in man. In fact, some consider all cases of superfœtation instances of superfecundation, stating that the latter is an impossibility. Many interesting cases are cited and some of these will be mentioned.

In lower animals superfecundation is well shown in those animals that give rise to hybrids. This is especially true in those animals with double uterus, yet in ruminants and ungulates it does not commonly occur. The mare will take the stallion or the jack, and cases are on record where mares have foaled a colt and a mule, having been successively mated to the stud and a jack. Again, a bitch may give rise to a mixed litter, indicating copulation with different dogs.

Among human beings there are also many cases on record and the most interesting will be mentioned.

Mercer cites the case of a negress who was married to a white and gave birth to a negro boy and a white girl.

Debouillon mentions a negress who gave birth to two well-developed males of equal size, one a negro and the other a mulatto. She confessed to intercourse on the same night with a negro and a white man.

Moseln states that a negress in Jamaica gave birth to two children of the same size, one a negro, the other a mulatto. She stated that she had had intercourse with her husband and shortly thereafter with a white man.

A similar case is reported in the *Gazette de Sante*, June, 1821.

Gare gives an instance of a white woman who had had intercourse with a white man and after due time gave birth to twins, one black and one mulatto.

Buffon cites a case that occurred in Charleston, South Carolina, in which a white woman gave birth to twins, one white and the other black. She stated that she had been forced into having intercourse with a negro just after her husband had had intercourse with her and left her.

Dewees cites the case of a white servant girl who gave birth to twins, one white and distinctly European in appearance and one black, with a distinct negro constitution. Although she did not admit an intimacy with a white and a black man, nevertheless as soon as the birth of the twins was known, a white and a black man who worked on the same farm, hurriedly left the neighborhood.

Bloch cites the case of an Indian woman who gave birth to triplets, one an Indian, one a Caucasian, and one a negro. She later confessed to intercourse with men of these three races in the order named.

SUPERFŒTATION

As previously stated, there are some who positively deny the possibility of the condition of superfœtation and explain such cases on the basis of retarded or arrested development of an ordinary twin pregnancy. According to Beck, Brassavolus, who lived between 1500 and 1555, said he had known superfœtation to be epidemic. While such a condition is extremely doubtful, it shows to what extent beliefs are sometimes carried. The reasons and arguments against the possibility of its occurrence will be first stated, then each will be discussed and interpreted.

1. By the seventh to the eighth day after fertilization, the ovum is usually in the uterus and the internal os and the oviducts are closed by a decidual mucosa. Soon a mucous plug forms in the cervical canal and as a result of these changes it is impossible for sperm to pass up the genital tract. Homs, Burns, and Magendie have shown that sometimes the ovum does not descend until the eighth, fifteenth, or twentieth day after fertilization (Cassan).

In reference to the mucous plug it might be said that it does not always form. Even Herzog, who did not favor superfœtation, states that he believes that the mucous plug is not an obstacle to the advance of sperm

and that it also is not found connected with pregnancy only, as it forms in the cervical canal of non-pregnant females also. Also cases have been noted in which the orifices of the oviducts were patent even in the third month. Haller even denied the existence of a mucous plug in pregnancy (as an indication thereof and a necessary sequela of fertilization); Hildebrandt and Valentin do not even mention it. Loeb also believes that the mucous plug does not form a positive barrier, but he believes that as pregnancy advances, the oviducts become closed, in lower animals especially. In addition, occasionally during pregnancy, the menstrual cycle continues and this fact would indicate an open passage. It was also formerly believed that the ovular decidua and decidua vera were soon (by end of the third month) fused and thereby closed all communication between the cervical canal level and the orifices of the oviducts. This is now looked upon as wrong as Minot showed that the ovular decidua (d. reflexa) degenerated early and becomes nought but a structureless, hyaline membrane. This was later confirmed by Herzog, so that a thin space might exist between the decidua vera and the ovular decidua, in early stages of pregnancy, and the sperm might readily work its way up to the oviduct therethrough.

Campbell states that occasionally during the second to the third month the mucous plug comes out and the intra-uterine space between the ovular decidua and the decidua uterina, is re-established so that the oviduct may be reached.

From the foregoing it would seem that in many instances the genital passage does not completely close during the early months of gestation, so that as late as during the third month it would seem that sperm could reach the oviduct, at least in some cases.

2. Typical ovulation ceases during pregnancy, that is to say it is so claimed by the adversaries of superfœtation. In connection herewith Lusk says that the idea that impregnation could occur at two periods distant from each other must be regarded as an inadmissible hypothesis until physiologists succeed in demonstrating, by corpora lutea of different ages, that ovulation occurs during pregnancy. Parvin also believes that ovulation probably ceases in pregnancy, also that if an ovum is liberated it cannot enter the oviduct as the decidua would have closed the orifice of the oviduct and with the mucous plug would prevent the sperm from getting to the ovum. The latter two points have already been discussed.

Whether ovulation invariably ceases at pregnancy in all cases is doubtful, but that it does cease in most cases is conceded by most writers. In lower animals it has been found that ovulation may occur during pregnancy.

The corpus luteum resulting from a ruptured graafian follicle does not atrophy and disappear at the end of a few weeks, as the ordinary corpus luteum spurium does, but continues its existence up until the eighth or ninth month of gestation. It has a number of functions as follows: (1) inhibition of ovulation during pregnancy; (2) assisting in the implantation of the ovum in the uterine mucosa; (3) stimulating the formation of a menstrual decidua; (4) stimulating the mammary gland to lactate; (5) and in the regular course of events it is said to cause menstruation; (6) it is also supposed to prevent the lodgment, or implantation and development of another ovum in the uterus already occupied by a fertilized ovum.

Christopher found that ovulation does occur in the cat during pregnancy of that animal. In a cat advanced in pregnancy he found four mature graafian follicles, each containing a mature ovum. This condition may occur during pregnancy in the mare also. He also cites Pouchet's case of a pregnant cow that had three corpora lutea in one ovary and two in the other and these were all at different stages. In addition to the large fœtus there was a smaller one of about 2 months of age. Longley found that coition was necessary to ovulation in the cat and particularly to maturation, therefore, a second coitus would be necessary for a second ovulation.

Loeb has shown, in guinea pigs, that pregnancy does not prevent an early ovulation if the corpora lutea were excised so that if the corpus luteum of pregnancy should undergo early involution, then ovulation could readily occur and superfœtation also.

Loeb performed a number of experiments upon guinea pigs in order to determine the influence of the corpus luteum. If a cut be made in the uterine wall or a foreign body be introduced into the lumen, 4 to 8 days after ovulation, then a placentoma will be formed. On the other hand the extirpation of the corpus luteum, early after ovulation, will prevent the formation of a placentoma. If the corpus luteum be removed within the first week after ovulation, then there will be a marked decrease in the sexual cycle of the guinea pig. He believes, therefore, that the corpus luteum inhibits the rupture of the graafian follicle. A periodic change that occurs in the uterine wall corresponds to the various phases of the sexual cycle. Pregnancy need not prevent early ovulation, after excision of a corpus luteum, but it does prevent the setting up of a new cycle in the uterine mucosa. Pregnancy, therefore, exerts an inhibitory influence on cyclic changes of the uterine wall, while it does not affect an early ovulation taking place after the excision of the corpus luteum.

Frankel, in 1903, experimented upon the corpus luteum of pregnant rabbits in order to determine the effect of destruction of the corpus luteum. He states that the destruction of the corpus luteum will cause the death and absorption of the conceptions up to the twentieth day of pregnancy.

Christopher believes that often an ovum is liberated near delivery of the child, as evidenced by instances of coition a week after delivery followed by pregnancy. Berthold also mentions a case in which a woman delivered of her child had intercourse with her husband 8 days later and this resulted in another birth 285 days later.

Of great interest is the case of Cosentino—a woman who died during the sixth month of pregnancy and exhibited a recent corpus luteum. He states that at present we do not know positively whether the development of the graafian follicle during pregnancy is sometimes interrupted or whether it suffers any special changes. Most authors on the subject, however, state that the change is a continuous one, extending over a period, yet he himself thinks the evidence is not yet sufficient to be positive. An examination of the specimen showed many follicles in which not only the various stages from the early to the mature follicles were present, but also proof of a ripe, ruptured follicle. The follicle measured about 15 millimeters in diameter and its edges were serrated. The theca had a rich network of arterial and venous vessels and at one side of the follicle among a lot of granular débris, was a ripe ovum with all its parts. So it seems that even in the human type the ovaries may carry on their function of maturation of the follicles to bursting of the follicles.

Mayrhofer contends that the corpus luteum of pregnancy, like the false corpus luteum of menstruation, disappears and is replaced by another at short intervals and that the belief that the corpus luteum of pregnancy lasts from 9 to 12 months is false. In support of this he mentions cases, or deaths following rupture of tubal pregnancy of 7 to 8 weeks' duration in which the corpus luteum is described as communicating with the peritoneal cavity by an aperture not yet cicatrized. The cases cited by Mayrhofer are from Luschka (1), Kussmaul (2), Tobege (1) and G. Braun (2). Mayrhofer considers these recent corpora lutea because, as he claims, if they were old, the apertures would not be open so long. On the other hand this description fits that of the case reported by Benham—a girl died during menstruation and the graafian follicle undergoing involution had all of the characteristics that a corpus luteum of pregnancy should have.

The question of corpus luteum of pregnancy seems to be a testy subject. The presence of a corpus luteum of apparent long standing was supposed at one time to lend weight to the theory of pregnancy, in medico-legal cases, but with the finding of an apparent corpora lutea vera in unquestionable virgins and the absence of a real corpus luteum in pregnant females after the fifth month, the importance of the significance of a well developed corpus luteum lost weight. So it seems that the corpus luteum changes are quite variable and the early involution of such a body might readily permit the maturation of another follicle and the liberation of another ovum dur-

ing the early months of a pregnancy, thereby permitting superfœtation.

It might be said that the implantation of an ovum and the development of another decidua in an already occupied uterus would seem the most serious handicap to superfœtation. If pregnancy and a corpus luteum verum inhibit cyclic changes in the uterus, then superfœtation cannot occur. Yet the adversaries to superfœtation admit that the uterine mucosa might be stimulated so as to form a mucosa.

Sertori (1906) after histological observations stated that a second ovum may become implanted in the uterine mucosa, while the decidual reaction is still slight, that is, during the early stages of pregnancy. Loeb, on the other hand, from experimentation upon guinea-pigs drew the conclusion that the uterine mucosa of pregnant guinea-pigs could not be stimulated to form a new decidua. He considered that an inhibitory influence was exerted during pregnancy, on the cyclic changes in the uterine wall; consequently the implantation of an additional ovum, in a uterus already pregnant, becomes impossible.

The connection between ovulation and menstruation is close according to some and not according to others. They are not necessarily synchronous, but in most cases menstruation is dependent upon ovulation. In most cases it is generally conceded that in general ovulation begins at about the same time of life and ceases at about the same time and for about 35 years they go on steadily hand in hand. Of the two processes menstruation is the less dependable. As stated above, one of the functions of the corpus luteum seems to cause the second succeeding menstrual flow. This function, however, may not be regular. There are cases on record in which pregnancy occurred before menstruation began (at 8 years of age) also after menstruation had ceased (several decades, 103 years. —Bloch). Again, some women never menstruated and yet have borne children. Some have been regular before the first pregnancy and irregular thereafter. Also some have menstruated only a few times a year and yet have become pregnant. In some instances menstruation has not occurred until after the first child has been born. So it seems that menstruation while a usual process in the normal, physiologically healthy female between the ages of 15 and 50 may be irregular, or absent, and yet not interfere with childbirth. Yet in all ovulation has taken place. Autopsies on women who have never menstruated showed the corpora lutea and alba, etc. That menstruation ceases at pregnancy through the inhibitory action of the corpus luteum verum may also at times be doubted. Menstruation in pregnancy up to as late as the fifth month has been known to occur. Also regular and irregular flows of blood have been known to occur during pregnancy, apparently indicating that the process of ovulation has continued. Some are inclined not to consider these discharges of blood from the uterus of pregnancy as true menstrual discharges, no matter whether they occur regularly or not. Of course, such an interpretation is too sweeping if it considers menstruation a periodic discharge of blood from the uterus without the presence of the product of conception.

The complete removal of the ovaries will in itself inhibit menstruation so that this process depends for its occurrence on the existence of maturing graafian follicles.

Bloch states that some women after bilateral removal of ovaries and tubes have continued to menstruate. That, to the writer, is open to serious question. It is not a real menstruation, but an erratic hæmorrhage, due to some other cause, or, what seems most likely, indicates the incomplete removal of the ovarian tissue; this is rather fortunate as it prolongs the changes due to the radical operation and rather ameliorates a too rapid and early menopause.

3. It is claimed that the oviducts of the pregnant individuals are too short suitably to apply themselves to the ovary so as to receive the newly ovulated egg. Also in pregnant animals, including human beings, the ciliary action ceases immediately with the onward movement of the ovum.

The first point could not readily be advanced as an argument against superfœtation in the first 3 months, as the enlargement of the uterus would hardly be sufficient to cause this change. In fact we know so little about

this that it does not come in very well as a point especially against the possibility of superfœtation. It has also been shown that ciliary action does not cease after the passage of the ovum.

4. It is also maintained that a pregnant uterus softens and varies so from the normal in function that it is unfit for its calling, so that a newly fertilized ovum could not continue to develop therein.

This statement seems a little rash and hasty as the uterus retains its capabilities often in various degenerations or deteriorations. Loewenhardt, in Prenzlau, reports a number of cases of conception and natural births in instances of uterine cancer. Adelmann reports a 46-year old woman afflicted with dropsy of the uterus, who, during the first 5 months of pregnancy, lost 5 to 12 quarts of water every 4 or 5 weeks. At birth she lost two pails full and gave birth to a living child. Stoll found in the uterus of a woman in childbirth (one who had passed the normal termination period) a twelve-inch polyp that weighed one pound and one-half ounce.

5. It is also claimed that through pressure within the uterus, due to the development and growth of the fœtus, maturation of another graafian follicle is impossible. Many experiences prove against this assertion. The presence and pressure of a hard body in the uterus is not sufficient, as is shown by the presence of polyps, dead fœtus, etc. These do not prevent the development of the uterus and the maturation of the graafian follicle. Haller reports many such cases in animals and human beings. Also there are many cases of extra-uterine pregnancies in which the fœtus died and became calcareous and encapsulated and was retained. Uterine pregnancies occur later in spite of this condition. W. Campbell collected evidence of such cases and found that nine with retained pregnancies became pregnant once; two, twice; one, three times; one, four times; one, six times; and one, seven times.

6. Another argument is that if superfœtation were possible, it would occur more often. This seems rather weak. Simply because it does not occur often, does not mitigate against its ever occurring. The discussion arising is not with reference to how frequently it can occur, but as to whether it ever occurs even though but once in a century. The mere fact that extracorporeal heart occurs very rarely, does not mean that it never does or cannot occur. The mere fact that cyclops is very rare does not signify that it cannot or does not occur. It is merely taking a stand that because a certain individual has never seen a certain thing, that thing does not exist. It places the one who advances such an argument in the position of the farmer who saw a giraffe for the first time, as he said "there ain't no such animal."

Dewees in 1823 states that although there were many cases of superfœtation on record at that time, this phenomenon was considered impossible. The main reason advanced was that the cervical os was closed by mucous plug after fertilization and so the passage was blocked; yet for those authentic cases some explanation had to be given, as will soon be considered. Other reasons were also advanced.

1. The male organ did not have the strength to force the semen into the partly blocked cervical canal.

2. The urethral orifice of the male and the cervical os of the female were not in apposition through the difference in length of the penis and variations in the depth of the vagina. Also the position of the uterus was variable. The uterus is a little lower after each childbirth.

3. As the vagina embraces the penis the aim is disturbed, also the soft parts are likely to deflect the semen.

4. The semen is very tenacious and therefore difficult to force into the cervical os.

Even if the semen entered the uterine cavity, the mucus present would obstruct its passage.

In the light of the state of knowledge of that day, we can readily appreciate these points, even though they are valueless today. At that time it was not known that the uterus at orgasm exerts a sucking action and so draws the semen into the canal from distant parts of the vagina; even when the semen is deposited upon the vulva, fertilization and pregnancy may readily occur. Again the

ciliary action of the ciliated cells of the uterus and oviducts causes a sort of current up the uterus and tube toward the descending ovum, so that usually about one and a half hours after the sperm is deposited in the vagina, it may be found on the ovary; that is because the spermatazoa swim better against the current established by the cilia than with it; in the latter instance they cease moving. In the light of knowledge of today with one fell swoop all these arguments are wiped out.

Still the manner in which they got around these points in Dewees' time is quite ingenious and is also an illustration of interpretation of facts, such as occurs even today.

It was thought at one time that the vagina absorbed the semen and that the latter was carried (1) by the blood current to the ovary and (2) absorbed by a special set of vessels called "seminal absorbents" that had direct communication with the ovaries.

1. This first theory was denied, as by that method the spermatozoa would become too alterated by the blood to be able to impregnate the ovum.

2. The second theory was believed and at this time they thought they had the proof of the absorbent vessels. It was just at the period that Gaertner discovered the remains of the ducts of the mesonephros (wolffian ducts) in the female. Ordinarily they atrophy and disappear, but at times they persist either in part or *in toto* and constitute the ducts of Gaertner. When the latter discovered these remains at the vulvovaginal region, he was sure he had discovered the seminal absorbents. It was so hailed and it was thought they extended directly to the ovary. One cannot blame them nor find fault with their interpretation. We have only to go back a few years and some of us embryologists have had to unlearn and relearn some embryology. Not so many years ago it was thought that the pancreas was derived from a dorsal diverticulum only, and how its duct managed to join with the common bile duct was an explanation both weird and unsatisfying to an analytic mind. Now we know the true facts and yet for the nonce we are no further advanced than in the time of Gaertner.

The argument advanced for the presence of seminal absorbents was both clever and logical to a certain extent. Dewees says that no one has shown the presence of lymphatics in the brain, yet every one admits their presence. No one has ever traced them, yet they are supposed to be present, so he felt they should take for granted the presence of seminal absorbents within the vagina, and some may be just outside the vagina and within the labia. It was supposed that the rugæ of the vagina held the semen in place and assisted it to liquify so as to spread readily over the vagina.

On the other hand if absorbent vessels were present why did they not also take up the gonococcus and lues and carry them to the ovary? Because these vessels were apparently stimulated to absorption only by the semen. To clinch this answer, the lacteals were cited as an example. These took up only food particles and not refuse. They were stimulated by chyle only. It has been proven that male semen alone would influence the ovum so as to produce conception, so that these vessels may respond only to certain stimuli. The question of relative sterility was explained by the answer that the semen of the first husband did not exert the proper influence (open sesame) upon the female seminal absorbent vessels and that of the second did. Yet no doubt these explanations sounded just as plausible as some of our present day theories will at a corresponding period hence.

In order to establish the occurrence of superfœtation, a number of points must be noted.

1. A marked difference in age and size between the two off-spring.

2. If labor occurs at full term for the first off-spring, there will be no lochial discharge and lactation does not begin. However, with the birth of the second off-spring these phenomena will occur.

3. If one is dead at the time of the birth of the other, this should have a fresh and unmacerated appearance showing that its death was recent.

4. Each off-spring has its own placenta usually.

5. There should be no indications of an extra-uterine hæmorrhage separating one placenta and so accounting for a difference in ages due to a retarded development.

6. The second conception retains its attachment to the uterus until after the birth of the older child. The uterus should contract and practically no hæmorrhage follow the first placenta.

Foderé states the following rules:

1. The lochia must remain absent after the birth of the first child.

2. The breasts should contain no milk. There should be no milk fever, although the breasts are well developed.

3. The patient feels movement of the second child soon after delivery of the first.

4. The abdomen remains enlarged and all the signs of a pregnancy should continue and not abate.

5. Skilled experts should readily prove the presence of a second child.

6. At the second birth a lochial discharge should appear, milk should flow, and the mother should feel all the usual sequelæ of an ordinary birth.

7. The second child is always stronger and better developed than the first one.

Some of the reported cases of superfœtation will be given.

Cassan reports the case of a woman who bore a female child of 4 pounds on March 15, 1810; still the uterus remained fairly large and on May 12, 1810, she gave birth to another girl of about 3 pounds. The times of intercourse were definitely given as July 15 and 16, 1809, and September 16, 1809.

Cassan cites Bauhin and Ruysch, who were partisans of superfœtation, and they reported a number of cases of which one was very certain. A woman gave birth to a child of full term and shortly thereafter passed a small fœtus about as long as a finger.

Cassan also cites the case of an Amsterdam surgeon who reported that a woman gave birth to a normal living child and 6 hours later passed a small embryo and placenta of about 3 months' development.

According to Mertens, Maton reported the case of an Italian woman of Palermo, the wife of an Englishman, who gave birth to a boy on November 12, 1807; on February 2, 1808, she gave birth to another healthy and fully developed boy. This was scarcely three calendar months after the first birth.

The *Encyclopédie Médicale*, of February, 1849, gives the following case: A woman who had had six children was pregnant with the seventh and on February 15, 1807, she gave birth to a well developed male child; the placenta came away normally. After birth the abdomen was still enlarged and the movement of a fœtus could be felt. Before the birth the uterus had shown a vertical furrow or groove. On March 15, 1807, she gave birth to a well developed male child.

Mertens also cites A. Duyes who reports the following: A woman aborted at the fifth month. The first fœtus was eight and one half inches long; this was followed by a second that was about three and one-half inches long, indicating about the third month according to him.

Arrowsmith cites Eisenmann's case of Marie Begaud, age 37, who gave birth to a full time boy on April 30, 1848. She had no lochial discharge and no milk. Fifteen minutes later she felt a movement in the womb and on September 16, she gave birth to a full term girl. This time she had a lochial discharge and lactation began. The second appeared four and one half months after the first child.

Desgranges of Lyons wrote of the following case to Foderé: Benoite Villard, age 27, had a miscarriage on May 20, 1779, and a month later was pregnant. On January 20, 1780 (eight months after the former miscarriage and seven months after the second conception) she gave birth to a girl. She had no fever, no milk, and no lochial discharge. The abdomen did not get much smaller, but increased soon thereafter. On July 6, 1780, she gave birth to another girl, 5 months and 16 days after the first birth. This was followed by a lochial discharge and milk. This interval is too long to indicate a protracted pregnancy.

Churchill reports the case of a woman who gave birth to a lively child on April 30, 1818, and on September 17 of the same year (four and one half months later) gave birth to another healthy and mature child. After the birth of the first there was a slight lochial discharge and milk started, but both soon ceased.

Arrowsmith cites another case, reported in the *Gazette médicochururgicale*, of a female of 32 who had never been pregnant and who menstruated regularly to June 15, 1845, and then the menses were suppressed. In August the menses returned twice in a fortnight's interval, so the idea of pregnancy was dismissed. Vomiting and sickness and other signs appeared and on February 28 she gave birth to a full grown male child. Shortly thereafter another fœtus of four and one half to five months of age appeared.

According to the *Lancet*, M. Langmore exhibited to the London Medical Society a supposed twin abortion. The case aborted about May 22, and a fœtus of about 4 months was found. It was flattened, atrophied and apparently had been dead for sometime. This was soon followed by another fœtus and placenta of about 5 to 6 weeks' develop-

ment. The society granted that this was a case of superfœtation.

Herzog reports three cases:

1. Dr. Spaulding delivered a woman on September 1, 1897. The child had been dead sometime and was macerated. A few minutes later another bag (about the size of a fist) with a small placenta at the side, all intact, appeared. The first was a female fœtus of about full term. The second one contained a compressed and macerated fœtus of 64 millimeters length.

2. Dr. Andrew. By abortion a woman passed an ovum of about 16 to 17 millimeters in diameter October 10. Another small and three to four weeks' old fœtus was in the uterus. He stated that the last menstruation had been August 15.

3. Dr. Whalen. The woman had had her regular menstruation up to March 15. On March 20 she had pains and an abortion. Two products of conception. One fœtus 6.2 centimeters in length and an embryo 6.5 millimeters in length.

Bloch on December 14, 1915, delivered a woman of a normal full term male child of 7 pounds. The placenta was soon expelled and this was followed by a second fœtus of about three and one half months of age. This was dead. There was some flattening, but no maceration nor abnormality. The placenta had two cords, that of the living child was attached to the center of the placenta, while that of the dead fœtus was attached to the margin. The placenta was apparently normal. There was one amniotic sac. Some of the members of the society, before whom this was reported, considered it a case of twin pregnancy and others considered it a case of superfœtation.

Gustetter reports a case. M. G. had several normal children and the last one April 10, 1917. She menstruated during the latter part of May for 15 days. In the latter part of July she again menstruated and had severe pains on both sides of the uterus. The next day she ceased to menstruate. After that she soon developed an erratic continuous menstruation and suffered extreme tenderness on external palpation of the uterus. September 16, she had a peculiar sensation in the abdomen for only a short time and then there was no repetition thereof. On September 18, she had more hæmorrhage and on September 21 was delivered of a fœtus of about 4 months of age and which had apparently died on September 16 when she had the peculiar sensation in the abdomen. The placenta was expelled shortly after the fœtus. In the cervix another whitish mass was noted and, upon examination, it proved to be a fœtus of about 50 days' development. Apparently the second fœtus lodged and developed near the margin of the older placenta, and as it grew it became more and more attached to the other placenta, causing hæmorrhage and pain. He believed the abortion was due to the fact that the second implantation was close to first placenta.

Flowers reported a case in which a white woman was delivered of an eight months old white female fœtus and a full time mulatto child.

Franco described a case of a fœtus of 6 months and another smaller one that were aborted at the same time. The smaller was well preserved and the membranes were intact. It was slightly distorted in the lumbar region and seemed 5 to 6 weeks old. Microscopic examination showed a marked necrotic change and Franco decided that it had been carried for 4½ months as a dead body. That seems doubtful to the writer, on grounds which will be advanced later.

A number of cases of superfœtation have been reported in animals. Arrowsmith reports such an instance in a ewe. A ewe 2 years old, produced a lamb on March 2, 1833, which was full term and healthy; on March 30 it had a second one. After the first one the ewe had plenty of milk. The second lamb was perfectly formed and healthy. The ram had been admitted October 8, 1832, and had remained from 4 to 5 weeks. This ewe apparently took the ram early and late. In the fall when the ewe was killed it was found that the uterus was normal. This could not be considered a case of overtime as the extreme limit of overtime in the sheep is said to be 11 days. In the horse and cow the limit is greater.

Jepson reported that in watching a cat give birth to its kittens, he saw one mature kitten followed by a mass the size of a walnut and this a little later was followed by another full time kitten. The small mass proved to be a fœtus about ¾ inch in length. The sac and all seemed in a healthy and normal state, so that it did not appear to be an instance of arrested development.

Harmon reports two cases of possible superfœtation. The first occurred in a cat and the second in a cow.

1. In the case of the cat the older fœtus was near term and the younger was about 7 to 8 weeks developed. Both were in the same state of preservation and the blood vessels seemed to indicate that the difference in size and development was not due to an early death of the smaller fœtus. The smaller cat was near the vagina.

2. The cow was mated December 22, 1916, and then kept by herself and then only for a short time did she run with other cows, but no males. On September 17, she gave birth to a normal heifer a little above average in size. On October 1, she passed a fœtus a little over 4 months old; the amnion and placenta were in a good state of preservation. It apparently had died a short time before abortion.

Hunt reports two unequally developed cats. The cat first gave birth to a small embryo and a few hours later had a normal full term kitten. The smaller measured 14.1 millimeters from crown to rump and probably represented about one seventh of full development, or about 2 weeks stage. Histological examination showed the organs to be clearly outlined, but some nuclear fragmentation was noted. It showed no external changes like maceration and the morphology seemed normal.

Kuntz reports four instances that might be looked upon as superfœtation. One cat uterus contained two full term kittens and two small fœtus, one 10 millimeters and the other a little less, in length. He reports another instance in a cat in which there were four fœtus. The larger two were about 70 millimeters in length and the two smaller ones representing a stage not much later than the closure of their neural tube. On the ground that each ovary contained two well developed corpora lutea of apparently the same age, from a microscopic standpoint, and that the microscopic examination of the fœtus showed marked maceration, he calls them instances of arrested development. The larger fœtus was toward the oviduct.

Another example occurred in a bitch. During an operation it was seen that she was pregnant with 6 fœtus, all in the same state of development, apparently. She recovered and later had her litter. She had four full term, two living and two dead, and one less than full term, but the sixth was unaccounted for. The smaller dead fœtus weighed about 40 per cent of a full term and it had no hair and was not appreciably macerated. Miscroscopic study of the organs showed them to be well preserved, but necrotic. He considered this arrested development also.

Mention has also been made of overtime and it might be well to call attention to another matter at this point, that of rapidity of successions of pregnancies.

Campbell states that he had paid much attention to the protraction of labor and finds that it might be lengthened by a week or a month. In three especial cases the times were 11, 13, and 18 days.

De Granville allows that for a period of 30 days after childbirth the female procreative organs are not capable of exercising their functions. This means that another child could not be formed for at least 304 to 310 days.

Bonnar had collected a number of such cases and found 10 of 300 to 309 days and all these second children were mature and healthy. Of those 290 to 299 days he found two instances and of those 280 to 289 days he found four instances.

In this connection a few questions might relevantly be asked.

1. What is the shortest interval likely to elapse after parturition before impregnation can again take place?

2. At what age of extra-uterine life is it possible for a child to be raised to such a period as to show that it had at least outlived the accidents and liabilities necessarily attendant upon premature birth?

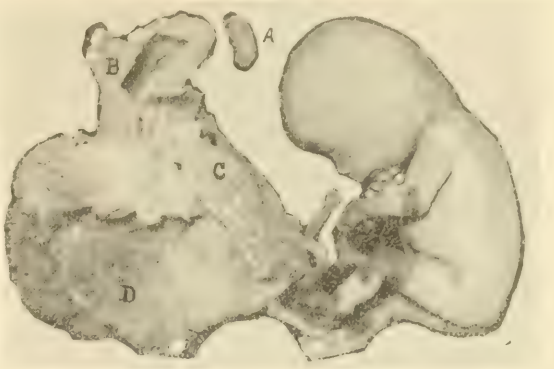

Fig. 1. Photograph showing the relative sizes of the two fœtus. *a*, smaller fœtus; *b*, sac for smaller fœtus; *c*, sac for the larger fœtus; *d*, placenta.

1. Bonner believes that 14 days after delivery is the earliest period at which the uterus can assume its functions.

2. It was formerly believed that a child would live any time after 3 months, but none had the powers of living to manhood or being reared, before the seventh calendar month.

A number of interesting cases are cited.

Hon. P. B. born 259 days after his brother and was alive at the age of 76.

T. H. T. P. born 238 days after his sister and lived 2 years.

L. C. H. born 162 days after the brother and lived to be married.

In a table of 105 premature births 69 survived upward of one day to many years. Bonnar also believed that a child ought to be at least 8 days old in order to be pronounced viable.

Brouzet, of Fontainebleau, physician to Louis XVI, cites a case in which a woman gave birth to a second child 6 months after a first one or 159 to 165 days after the first. This may have been a case of superfœtation.

In the family of Baron A. the fourth child was a daughter and the fifth was born 173 days thereafter and survived 28 days. The gestation period would be only about 159 days then.

Lord C. J. G.'s daughter was followed by a son in 127 days (113 actual development). This is 67 days less than the lowest viability period.

According to Bonnar the last three cases are real superfœtation. All the foregoing are authoritative cases from Burke's and Lodge's Peerage.

In Velpeau's *Elements of Midwifery*, he cites the case of Madame Begaud mentioned in the early

Fig. 2. A sketch of the smaller fœtus magnified four times.

part of the paper. Campbell calls it a case of protracted pregnancy and yet in his own work states that the lowest overtime is one month and yet the case above is 53 days overtime. Campbell states that he devoted much attention to this condition and in his chapter on "Duration of Pregnancy" he states the term may be lengthened by a week or a month.

He cites three cases of 11, 13, and 18 days overtime. General modern jurists (in 1835) allowed 293 days as the time of gestation. The Napoleonic Code allowed 300 days and the Prussian law 302 days. Bonnar cites the *American Journal of Medical Sciences* as reporting a case of 317 days. Professor Simpson, in the *Edinburgh Monthly Journal*, July, 1853, cites 4 cases in his experience. Two in exactly 280 and one in 336 days and the other in 319 days. If we allow 23 days as average time between the cessation of one and the beginning of another, then the actual time of the last two would be 313 or 296 respectively, and of the first two 257 days.

Having presented a review of some of the literature upon the question, I will describe the specimen in my case. The report was made to the writer by George F. Spencer who received the specimen in the routine of undergraduate obstetrical work.

The specimen was apparently the product of a spontaneous abortion and appeared in good condition. It had been placed in a weak solution of formalin soon after the delivery so that degeneration and necrotic changes were controlled. It consisted of a larger fœtus of about a 4 months' pregnancy, with umbilical cord and placenta intact. The sac had ruptured so that the fœtus appeared before the placenta and sac. Upon the margin of the placental area of the sac was what appeared to be a cyst, but when this was opened it was found to contain a smaller fœtus of about 18 millimeters length. From examination, the smaller fœtus was found to be of about 38 to 40 days' development. This fœtus was free in the sac, as its umbilical cord had been torn from the body at the abdominal wall, where the ragged scar and the abdominal viscera could be noted. The appearance, however, was such as to lead one to believe that the disconnection was recent as the fœtus did not seem at all macerated, but appeared normal. Both fœtus were photographed and the smaller also sketched at a four times enlargement.

The history is as follows: The abortion occurred on October 12, 1919. The mother was 25 years of age and had been married 2 years and, although nothing had been done to prevent pregnancy, this was the first instance. There is no history of disease in either parent. The last menstruation occurred 3 months and 2 days before the abortion. Following the first period missed, she suspected pregnancy, but had intercourse at intervals up to probably a week before the abortion. There is no history of trauma, fall, or injury of any kind. Recently she had suffered from increased constipation and had taken a heavy dose of castor oil and these are the only contributing factors known.

The larger fœtus is that of a female and measured 11.6 centimeters from crown to coccyx. The lower extremities show several darkened areas under the skin that may be ecchymotic in nature. The external morphology is normal and in no way indicative that the fœtus had been dead very long. The ears are completely formed and normal, the eyelids are firmly united, the lips are slightly parted, but the nostrils are closed with a mucous plug on each side. The extremities are normal in appearance and proportionate in size to the trunk. The nails are also well started. The cloacal area has been completely divided, the anus established and normal, and anal orifice patent. The genitalia are well developed and normal in appearance. According to Mall's method of computation the fœtus is 16 to 17 weeks of age and the general morphology and developmental stages of exposed parts warrant that conclusion also.

The smaller fœtus measured about 18 millimeters in length. The formation of the eyeballs is normal for this length, the pigmentation of the retina being distinctly noticeable and the white patch of the epithelium indicating the formation of the lens, is characteristic.

The nasal pits are indicated as dot-like areas and the upper jaw is still incomplete, while the mandible is complete indicating, from facial development, about the thirty-eighth to the fortieth day. The tuberculum impar portion of the tongue is clearly visible in the small oral cavity. The external

auditory canal portion of the first external brachial pouch is characteristic of this stage. The trunk portion shows the usual development and the near pubic area is the torn edge of the abdominal wall where the umbilical cord has apparently been torn loose. A short tail-like point of the coccygeal region is noticeable. Each limb bud shows a division into two portions, arm (1) and forearm-hand (2) divisions for the pectoral appendage and the thigh (1) and leg-foot (2) divisions for the pelvic appendage. The stage of the limb buds might be considered a few days under 40 days.

There is one combined sac or membrane mass for the two. The umbilical cord is about 19.5 centimeters long and shows only a few twists and knots, but intact throughout; its attachment to the placenta is excentric. The placental portion is 8.5 centimeters in diameter and it measures 1 to 2 centimeters in thickness. At one side is the sac for the second fœtus. This measures about 4 to 4.5 centimeters in diameter and the small umbilical cord has an excentric attachment. This sac is an independent one and by careful manipulation can readily be separated from that of the larger fœtus except at the placental area where the fusion is real and not due to mere pressure, as is indicated on the sac proper. Between the two sacs where they are attached to each other by pressure union, there is a layer of tissue 1 to 2 millimeters in thickness that looks like an early decidual tissue, but in all probability represents a portion of the chorion frondosum and læve of the younger sac compressed against the larger sac as the embryo grew. From its thickness and general state it seems as though it is younger tissue than the larger sac. This layer of tissue is continuous with the placental part of the smaller sac just where this blends with the placenta of the larger sac.

After a careful study of the specimen the writer considers this a case of superfœtation.

The marked difference in sizes and the seemingly excellent state of preservation seem to indicate this, although the smaller fœtus was disconnected through a torn umbilical cord. Even though it may have happened a week before that would account for degenerative changes in the organs, and still there could not be marked maceration of the skin.

The claim of some is that a dead fœtus may be kept *in utero* for a long period and not show an extensive maceration. This may be after the fifth month when the skin glands are preparing the vernix caseosa; that in itself protects the skin from maceration. After that time perhaps the fœtus may be dead for months and not show marked external change, but the writer does not consider that possible in younger fœtus, especially those up to 12 to 16 weeks of age. Development and differentiation have not gone far enough to render the skin self-protecting and consequently the smaller the fœtus the more readily it will macerate and disappear. In the case of the dog in Kuntz's case, he states that 6 fœtus in healthy state were present at the time of operation, only 5 were born and some of these dead. What became of the sixth? No doubt it macerated, distintegrated, being under the protective age, while the others that lived a little longer until they reached that stage and then died, remained *in utero* until term.

Although there is no way of proving the following, yet the writer would like to believe that the smaller sac was toward the opening of the oviduct, that is, represented a product of fertilization that entered the uterus after the older (larger) one. In other words, this smaller fœtus represents an ovum that was fertilized about 9 to 10 weeks after that of the larger fœtus.

The reasons for so believing are: (1) the difference in developmental stages, (2) the fact that unquestionably there were two distinctly separate original sacs, and that this could not be a twin pregnancy with fused sacs, because of the differences in development of the two fœtus and because of the layer of tissue between the apparently fused sacs. This fusion as already pointed out is only apparent and due to the pressure except at the placental area where a real fusion occurred.

Just as positive that some are that superfœtation cannot occur because ovulation ceases during pregnancy, just so positively would the writer like to assert that no young fœtus could exist dead 2 or more months without showing marked signs of decomposition and maceration.

The stand taken that because superfœtation does not occur frequently, is the one reason why it does not occur at all seems puerile. All rules have exceptions, but those exceptions are not common or they would not constitute exceptions. Simply because a thing has not occurred previous to a certain time, does not mean that it can never occur.

How about the flying machine, wireless telegraphy, and wireless telephony? How about transplantation of organs, fruit grafting, etc.? No doubt our predecessors said it could not be done, but it has been done.

Again to state that ovulation ceases invariably during pregnancy is also wrong. It has been proven to occur in lower animals and in human females. As an exception to the general rule why should not a corpus luteum of pregnancy undergo early involution and and thereby remove the inhibition of its internal secretion and permit another follicle to mature and rupture one, two, or three months later? If this has occurred why should there not in these early months be still space enough for spermatozoa to work their way up into the oviduct and fertilize such an ovum?

Again sperm may live for one month in the female genital tract, and perhaps longer, and some believe the viability of the ovum to be greater than one week. In the hen the sperm may live for 35 days. With these facts in mind, if spermatozoa have waited for a month, or more, in the oviduct and entered it only one month after the first fertilization, that would make a difference of two months in the two products of conception. Again if the spermatozoa entered 8 weeks after the fertilization, the writer still believes (as others who are not believers in superfœtation also admit) that spermatozoa could still get up into the oviduct in some cases and by waiting another month fertilize an ovum and make a three months difference in the two products of conception.

Of course, superfœtation is rare. It cannot occur frequently as all the factors in favor of it must exist at the same time, a chance in a thousand or in a million, but we must never forget that the millionth chance does exist and will come to pass at some time. After a three-months interval, the occurrence of superfœtation is quite doubtful.

This case, in the writer's opinion, indicates a superfœtation in which the difference between the two fœtus represents about 2½ lunar months, also that the second product entered the uterus, made a complete placental fusion, but only an apparent fusion of the sacs.

In conclusion the writer desires to thank Dr. Spencer for the opportunity of presenting this specimen and Dr. J. Parsons Schaeffer for his suggestions.

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DEPARTMENT OF TECHNIQUE

BREAST INFECTIONS[1]

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THE pandemic of influenza which made its appearance in the fall of 1918 and again in the winter of 1919–20, left in its trail a lowered resistance to the pus-forming organisms. This fact has been noted by so many observers in such widely variant specialties that we believe it may be stated without the fear of contradiction.

Breast infections in the Michael Reese Maternity showed a distinct increase in such direct chronological sequence to these waves of influenza that it was thought desirable to utilize this situation in two directions: first, to obtain confirmation from other maternity clinics throughout America of the etiological explanation mentioned above, and second, to make an analysis of the technique of breast care in these clinics both in the normal breast and in the various types of infection in order to arrive, if possible, at a procedure that seemed best calculated to prevent suppuration.

To this end interrogatories were sent throughout the country to maternity clinics the hospital data of which, as furnished by the editor of the *Journal of the American Medical Association*, seemed to indicate that their services were sufficiently large to enable them to reach conclusions based on a sufficient number of cases. Answers have been obtained from practically all the institutions so addressed, many of the answers entailing considerable work on the part of the contributors. The writers desire to express their indebtedness and appreciation of these efforts and hope that the data here presented may, in a measure, compensate them.

In the Michael Reese Maternity during the period between January 1, 1917, and October 1, 1918, *i.e.*, the pre-influenzal period of 21 months, there were 1,555 service cases with 4 cases of breast abscesses (0.26 per cent), 528 staff private cases with no cases of breast abscesses, and 240 outside private cases with one case of breast abscess (0.42 per cent), a total of 2,323 cases with 5 cases of breast abscesses (0.23 per cent).

During the period between October 1, 1918, and December 1, 1919, there were 702 service cases with 5 cases of breast abscesses (0.71 per cent), 363 staff private cases with 9 cases of breast abscesses (2.48 per cent), and 147 outside private cases with 3 cases of breast abscesses (2.04 per cent), a total of 1,212 cases with 17 cases of breast abscesses (1.74 per cent).

Among the 17 cases of breast abscesses quoted above, 4 had had influenza of varying degrees of severity while pregnant, 2 had had a "severe cold," in another case the husband had had influenza during the pregnancy of the wife, and 6 gave a negative history of "cold" or influenza themselves or in the household during the period of pregnancy. The remaining 5 could not be traced.

In the interrogatory two questions bore on this point. Answering the first question "Have you noticed an increase in the percentage of breast abscesses since the influenza epidemic of last fall and to what extent?" among 29 clinics, 2 answered "nearly double," and "apparently so." The remainder answered either "no" or left the question unanswered. Answering the second question "Has this increase, if any, been chiefly or entirely among patients who had influenza during their pregnancy?" 14 failed to reply, 9 said "no" and noted "no relationship."

We believe that these negative answers would, in many instances, have been positive, had the possibility of such a relationship been called to the attention of the profession early in the epidemics.

The Michael Reese Maternity has a definite routine for the care of the breasts and this is adhered to in all service cases and in the staff private cases. Physicians in charge of private outside cases usually follow this routine but vary it at will. An analysis of the technique of the Michael Reese Maternity is here presented in conformity with the 18 questions of the interrogatory, followed by the replies of the 29 clinics to the same questions, classified on a percentage basis, the answer which has been subscribed to by the greatest number being given first in each instance:

[1]Read before the Chicago Gynecological Society, November 19, 1921. (For discussion see p. 376.)

	1. Do you have a prenatal clinic?	2. What attention is paid to the care of the nipples and the breasts during pregnancy?	3. What treatment, if any, do nipples and breasts receive on patients' admission when in labor?	4. Do you use breast binders? If so, what kind?	5. What special protection, if any, do the nipples have under the binders?	6. What attention, if any, is given the nipples before and after each nursing?	7. Do you make an attempt to cleanse the mouths of the babies before and after each nursing?	8. HOW DO YOU TREAT— a. Painful nipples?	b. Fissured nipples?	c. Bleeding nipples?	d. Retracted nipples?
1	Yes	Cleanliness with boric wash	Cleanliness	Only to prevent secretion	None	Boric acid wash	Sponge with boric acid solution	Cleanliness and nipple shield	No routine	No routine	Manipulation
2	Yes	Wash twice daily with boric and alcohol if sore	None	Vest shaped binder if sore or pendulous or painful	None	Boric acid wash	Sponge with boric acid solution	Nipple shield, glycerite of tannic acid, comp. tinct. of benzoin or 25 per cent balsam of Peru after nursing			Pt. pulls them out in pregnancy or nipple shield
3	Yes	Astringent lotion or softening cream	Soap, water and sterile pad held on by binder during labor	Brassiere or Richardson type as needed	Sterile gauze	Boric acid	None	None	We use a nipple shield for all types—also $AgNO_3$ or tinct benzoin comp. otherwise as indicated—no routine—no nursing if nipples are badly retracted		
4	Yes	Castile soap and nail brush. Cocoa butter if sore	Soap and water and nail brush	Many-tailed binder for engorgement or pain only	Sterile gauze	Boric acid with sterile cotton	Boric acid	Ice cold pack	10 per cent $AgNO_3$. Comp. tinct. benzoin and shield	Cold glass nipple shield	Massage, breast pump
5	Yes	Daily massage followed by boric wash	None	No	None	Boric acid	Boric acid	None	Nipple shield	Nipple shield	Gentle traction 4 times daily
6	Yes	Olive oil twice daily	None	Muslin binder shaped to body	Sterile cotton and sweet oil	Boric acid before and after	Boric acid	None	Nipple shield + $AgNO_3$ stick no nursing		Pump 2 times daily in last month
7	No	Soap and water	None	Shoulder strap type	None	Boric acid	None	Comp. tinct. of benzoin	10 per cent silver nitrate + sterile dressings		Breast shield
8	No	Massage oil only if depressed	None	Support only if heavy	Sterile gauze	Boric acid	Boric acid	Nothing but shield	Boric acid, bismuth and vaseline, nipple shield		Massage and shield
9	Yes	Olive oil, glycerine and support if necessary	None; 1:4,000 bichloride after delivery	Unbleached muslin	Boric	Boric acid and olive oil	Boric acid	Nipple shield and olive oil	Nipple shield, olive oil and bismuth paste		Shield or artificial feeding
10	Yes	Daily massage with vaseline or lanolin for last 3 months	None	Simple support if heavy—no binder	None	Boric acid before and after	None except boric once daily	Massage with olive oil or lanolin	$AgNO_3$ after nursing	Nipple shield and olive oil	Massage with lanolin and nipple shield
11	Yes	Constant attention and instruction to women	Sterile dressings	Yes	Sterile dressings	Boric acid	Boric acid once daily	Soothing applications	Argyrol or $AgNO_3$	As indicated	Try to develop nipples
12	Yes	Bathe often	Bath	Y binder is routine, Murphy binder if not nursing	Clean towel	Boric acid	Boric acid once daily	Nipple shield	Silver nitrate stick or a 10 per cent solution		Draw out by means of a nipple shield
13	Yes	Hygienic	After delivery scrub with water, boric, 50 per cent vaseline and sterile pad	Richardson Y binder	Sterile breast compress	Boric acid and sterile vaseline	None	Boric acid and vaseline and 50 per cent vaseline before nursing—comp. tinct. of benzoin after—also nipple shield			Nipple shield or breast pump
14	Yes	None; patients too ignorant, or talbolene for last 8 weeks	None	Breast sling but no binder	Sterile gauze	Boric acid	None	Proper nursing schedule, nipple shield and cleanliness			Prenatal pulling for 4 months
15	Yes	Cleanliness	After labor, wash with green soap and boric and unguentum lanolin and vaseline	If necessary, a Y binder for support	Lanolin and vaseline ointment	Boric acid and vaseline and lanolin ointment	None	Lanolin and vaseline ointment	Comp. tinct. benzoin, $AgNO_3$ stick or castor oil and bismuth paste	Nipple shield	Nipple shield

16	Yes	Last 6 weeks use soap, water and peroxide, dry and massage outward with vaseline	None	Binder only if breasts are heavy or pendulous	Cleansed with sterile water	Sterile gauze	None	Glass nipple shield, comp. tinct. benzoin, zinc oxide ointment, and sterile gauze			Hard problem; we use wood nipple shield
17	Yes	Support – Wash nipples with 50 per cent alcohol and bland ointment daily	None	Breast binder of unbleached muslin with shoulder strap	Wansboro Pb nipple shield or gauze and adhesive	Nipples washed before and after with boric	Before and after with boric acid or 2 per cent potassium chlorate	Lead nipple shield	Comp. tinct benzoin, "Plantago" and boric acid on gauze or if bad, use $AgNO_3$ 10 per cent		Begin with nipple shield; nothing if very bad
18	Yes	Soap and water and draw out nipples 5 to 15 times daily; 50 per cent alcohol twice a week	Cleanliness, castile soap and water	Only for special indications	Sterile dry gauze	Cleansed with boric after each nursing	Only once a day	Cleanliness and lead nipple shield			Same with long nursing periods
19	Yes	Bathing with boric acid solution	Cleanliness	None		Boric acid solution		Dressing of boric acid solution or comp. tinct. of benzoin			Traction by nurse or Dr.
20	Yes	None	Soap and water postpartum	Yes—jacket	Sterile pad	Wiped with boric acid solution	Swabbed once daily with boric acid solution	Shield (?)	Comp. tinct. of benzoin, alcohol compresses or silver nipple shield		Nipple shield
21	No	Washed with soap and nipples touched with alkolene	None	Strong muslin made to fit—pinned down in front and over shoulders	Covered with sterile gauze	Washed with boric acid before and after nursing	None	Use nipple shield	20 per cent $AgNO_3$ with toothpick swab	Have had none	Sponge with cold water, hold out for 5 minutes, 4 times daily
22	Yes	Directed to bathe frequently	None except general bath	No	None	Alcohol and boric before and after nursing	No! Too many parasitic thrush like growths before we stopped	Witch hazel or 50 per cent alcohol compress	Balsam of Peru comp. tinct. of benzoin, shield p.r.n. glycerite of tannin	No nursing till relieved then with shield	Pull during pregnancy, then use nipple shield
23	Not Yet	None	Wash with soap and water, rinse, keep dry and sterile	Unbleached muslin fitted over the shoulders	Dry sterile gauze	Soap and water and rinse with sterile hands	No—face and lips are cleaned with sterile water—O in the mouth	Seldom treated	Clean them and no nursing for 2 hrs. Use pump and later a nipple shield		Mechanical suction for retraction
24	No	None if normal	Yes—Roller	Yes—Roller	Wash and dry and sterile gauze	Wash and dry and boric acid	None	Nipple shield	Nipple shield and boric acid	No nursing; use pump and boric	Vacuum
25	Yes	Careful cleansing twice daily with 50 per cent glycerol of tannin in water	None except as indication arises	Yes—Murphy breast binder	Gauze dressing over nipples	Wiped off with boric pad before and after	Always before and after with boric acid	Shield and sedative and wean if necessary	Shield and equal parts of castor oil and $BiNO_3$;	silver nitrate and shield if necessary	Breast pump, nipple shield, wean if necessary
26	50% seen before	Scrub daily with increasing vigor	None	Plain binder for support if necessary	Sterile gauze	Nipples washed before and after	None	Use nipple shield and pump enough for baby or rest the nipple. Comp. tinct. benzoin or castor oil and bismuth			
27	Yes	Particular care—alcoholic solution for nipples—massage p.r.n.	None but cleansing	Yes—shoulder and breast	Covered with sterile gauze	Yes—½ saturated solution of boric	Yes—½ saturated solution of boric acid	Ointments based on comp. tinct of benzoin and nipple shields			Breast pump
28	No	Only private cases—alcoholic wash or fatty substance	None	Plain strip of cloth for support only	Gauze and binder—cold cream	Boric acid before and after nursing	Wash once daily without regard to nursing	None	Shield and comp. tinct of benzoin or Bi and castor oil	Breast pump and no nipple shield	Support and ice massage and pump p.r.n.
29	Yes	Cleanliness	Cleansed with green soap and water	Murphy breast binder	Sterile gauze and Pb shield	Boric acid	None	Glass nipple shield	5 per cent $AgNO_3$ or comp. tinct. of benzoin	Stop nursing, pump milk and lead shield	Lead shield and breast pump

	9. Have you a special procedure at the time of the incoming of the milk, for the control of breast congestion and the pain?	10. How do you treat a lump in the breast in the absence of fever?	11. What do you do if patient has a chill, fever, a painful spot and leucocytosis?	12. What has been your percentage of breast abscesses occuring in the maternity or shortly after leaving?	13. Have you noticed an increase in percent of breast abscesses since the influenza epidemic which began in Sept. 1918, and is what stated?	14. Has increase, if any, been chiefly or entirely among patients who had influenza during their pregnancy?	15. Have you noted a lower percentage in the past year in the frequency of suppurative and non-suppurative?	16. What organisms have you found to predominate?	17. What is your usual surgical procedure in the presence of abscess?	(a) 8. How do you suppress breast function in cases of a still-birth? (b) Death or removal of baby after nursing has been well established?
1	No routine — binder ice-cap	Gentle massage or binder	None occurred	Have had none						Snug binder and belladonna plaster; empty if necessary
2	None	None unless tumor or infection is present	Ice and incision and drainage	1.13	No		No	Staphylococcus	Drainage	Binder, saline cathartics and ice-bag
3	No — careful use of breast binders and hot and cold applications	Strap firmly with adhesive plaster	Binder and ice and adhesive	1.5—1917 3.0—1919	Double	??	??	??	Free incision	Binder for 12 days; watch bowels and diet
4	Single binder, no fluids and emprin or codeine	Absolute rest of breast and heat or cold	Remove baby and binder and ice bag	0.00 in hospital 1918 0.5 after 1919	No	No	Yes	Staphylococcus Streptococcus	Free incision and drainage under gas	Breast binder, ice-bag, no liquids, codeine
5	None	None	Ice locally and no nursing	1.0	Yes 4 times	No	No	Staphylococcus	Incision and drainage	Do nothing — allow secretions to dry up, codeine for pain
6	Saline cathartic 36 hours postpartum	Compresses of hot sterile water	Remove baby, pump and heat and cathartic	Less than 0.25	No	No	No	Staphylococcus	Through and through with rubber tubes	
7	No routine but binder and ice-bag	No routine		Have had none	No	No	No		Incision and drainage and wet dressings	$MgSO_4$ q. a.m. tight binder and express milk
8	No routine Use heat	Leave it alone	No routine	Less than 1.0	No		No		As surgeon directs	Binder, saline cathartic
9	Binder and restrict fluids	Massage and ice-cap	Ice — drain if necessary	0.41	No	No	No	Staphylococcus	Free drainage	No special prescription in some support or Bier's congestion
10	Ice-caps	Ice-caps	Ice to breast — heat to body	Very small — 2 cases last year	No	?	No cases	??	Radiating incisions and drainage	Compression breast binder and massage
11	$MgSO_4$ at end of 24 hours and restrict fluid	Antiphlogistine, ichthyol, ice, and support	Ice-caps	Less than 1.0—3.4 per year	We are getting less			Staphylococcus aureus in all	Crucial incision and free drainage	Leave breasts alone — ice and morphine
12	Free cathartics and restriction of fluids and ice		Same	About 1%	No	No	No	Staphylococcus	Transfer to gynecologist for treatment	Diet, compression and medication — empty p.r.n.
13	Binder and ice	Ice constantly and stop nursing	Same	0.04; 0.08 need ice-bags	No		No		We refer all cases to surgical department	Free catharsis, restriction of fluids, Murphy binder, no compression and hands off
14	Support and morphine if necessary	Let it alone aside from support	Same	1.33	No	No	No	Staphylococcus	Free incision and gauze packing for 3-4 days	Binder for comfort, ice and catharsis if necessary
15	No	Empty by nursing baby twice on same side and ice-bag for pain	Support and ice	Have gone 2 years without any	No		No	Usually staphylococcus aureus	Wide incision and drainage and Dakin's solution	Sling and morphine

16	Aspirin grs. X q. 4 hrs. codeine p.r.n. and if heavy, support	Empty by nursing and ice-bag	Stop nursing — ice-bag $MgSO_4$ and binder	0 in last 4 years—over 4,000 cases	No	No			Open and drain at lowest possible point	Binder, restrict fluids and $MgSO_4$
17	Hot camphorated oil massage through flannel and no fluids and $MgSO_4$	Same	Empty by nursing and binder	0.4 in hospital; 1.2 after leaving first two weeks	No	No	No	Cannot make positive statement	Incision and drainage	Leave alone except for binder and sedatives
18	Draw out with sterile gloves and suction	Empty by nursing — breasts are to be used	Ice and $MgSO_4$ and tinct. phytolacca	0.00 in last 1,000 cases; 0.2 after leaving	No	No	Yes	Staphylococcus	Wide radiating incision	Binder and $MgSO_4$ and restrict fluids
19	No	Empty breasts by pumping	Empty by nursing and no fluids	0.15—1918 0.52—1919	No	No	No	Staphylococcus and streptococcus	Incision and drainage	Binder, ice-bag, saline cathartic
20	No—restrict fluids	Ice-bag	Same and ice-bags	0.16	No	No	No		Open and drain	Limit fluids and purge
21	$MgSO_4$ every other morning and tight binder	Massage	Ice-bag and rest for breast	Practically nil	No		No		Radial incision and drainage	Binder and ice-bag, and catharsis and restrict fluids
22	Nothing, except increase the nursing interval	Hot wet compress q 3 hours for 15 minutes and nurse or pump-ice-bag between times	Same, incision if fluctuating	0.8	No		No	Mixed streptococcus and staphylococcus	Incision and Carrel Dakin method	$MgSO_4$, no fluids and binder
23	Snug binding and occasionally a coal-tar for analgesic	Expectant if local condition does not contraindicate	Binder, catharsis, hot stupes	None					Generously free radial incisions	Snug padded binder, restriction of fluids, catharsis, no pumping or manipulation
24	Restrict fluid and pump	Suspend nursing and pump	Suspend nursing	None	No				Incise and drain	Camphor and pressure
25	Saline purge, binder and massage if necessary	Same with hot fomentations	Pump if no abscess	None	No	No	No	Various kinds of staphylococcus	Radial incision and adequate drainage	Light binder, saline cathartic, pump and massage
26	Soften by massage after nursing if necessary	Careful massage after nursing	Ice—no massage	About 1	No	No	No	Staphylococcus	Free drainage	Binder and morphine
27	Hot compresses	Hot compresses and massage p.r.n.	Hyperæmia or incision	The larger percentage after	No	No	No	Staphylococcus	Wide incision	Support and restrict fluids
28		Gentle massage	Ice, pump, support—no massage	Less than 1 per cent	No	No	No blood counts	Staphylococcus	Incision and drainage	Restrict fluid, tight binder, ice, narcotics
29	Support breast and use ice-cap	Light massage and ice-cap	Laxative, restrict fluids, ice-cap	1916—0.0 1917—0.5 1918—0.1 1919—0.3	No	No				Ice-cap and support

1. Do you have a prenatal clinic?

Michael Reese Hospital: Yes.

Other clinics: 78 per cent have, 22 per cent do not have prenatal clinics.

2. What attention is paid to the care of the nipples and the breasts during pregnancy?

Michael Reese Hospital: Routine examination of breasts and nipples at the first registration of pregnant woman, instructions as to soap and water, cleansing of nipples, traction and massage for retracted nipples, and mechanical toughening as a routine.

Other clinics: 28 per cent use simple cleanliness; 24 per cent use oil or other fatty substances; 17 per cent use alcohol and cleanliness; 17 per cent have no care of nipples or breasts during pregnancy; 14 per cent use boric acid solution.

3. What treatment, if any, do nipples and breasts receive on patient's admission when in labor?

Michael Reese Hospital: Scrubbed with soap and water, rinsed, bathed with 1:6000 bichloride of mercury, and clean maternity gown put on.

Other clinics: 41 per cent have no treatment on admission; 17 per cent use soap and water; 14 per cent use soap and water and boric acid solution; 12 per cent use soap and water and boric acid postpartum; 12 per cent use sterile gauze; 4 per cent use 1:4000 bichloride solution postpartum.

4. Do you use breast binders? If so, what kind?

Michael Reese Hospital: Yes, fitted breast binders with shoulder straps.

Other clinics: 28 per cent use no binder; 28 per cent use binder only for special indications; 17 per cent use vest or shoulder strap type; 14 per cent use Richardson type; 7 per cent use Murphy binder; 3 per cent use many tailed binder; 3 per cent unbleached muslin shaped to body.

5. What special protection, if any, do the nipples have under the binders?

Michael Reese Hospital: Square of sterile linen over the nipples.

Other clinics: 62 per cent use sterile gauze or cloth; 22 per cent have no protection for nipples; 8 per cent use oil or ointment and sterile gauze; 8 per cent use nipple shields.

6. What attention, if any, is given the nipples before and after each nursing?

Michael Reese Hospital: Swabbed with 2 per cent boric acid solution before and after each nursing.

Other clinics: 83 per cent use boric solution on nipples before and after nursing; 10 per cent use boric solution and oil; 6 per cent wash with water.

7. Do you make an attempt to cleanse the mouths of the babies before and after each nursing?

Michael Reese Hospital: No.

Other clinics: 45 per cent do not cleanse babies' mouths; 41 per cent use boric acid; 14 per cent use boric acid only once daily.

8, a. How do you treat painful nipples?

Michael Reese Hospital: Tea strainer open-air treatment —glass nursing shield.

Other clinics: 21 per cent use nothing; 28 per cent nipple shield (glass) only; 21 per cent, nipple shield and compound tincture of benzoin, or vaseline, or silver nitrate solution; 10 per cent, bland ointments only; 10 per cent, ointments only; 6 per cent, only compound tincture of benzoin; 4 per cent, sedatives only.

8, b. How do you treat fissured nipples?

Michael Reese Hospital: 10 per cent silver nitrate solution; tea strainer open-air treatment.

Other clinics: 60 per cent use nipple shield and compound tincture of benzoin, balsam of Peru, or alcohol; 10 per cent, argyrol or silver nitrate; 10 per cent, boric acid or bismuth and castor oil; 7 per cent, nipple shield and cleanliness; 7 per cent, nipple shield and cleanliness and silver nitrate; 3 per cent stop nursing; 3 per cent do nothing.

8, c. How do you treat bleeding nipples?

Michael Reese Hospital: Compound tincture benzoin.

Other clinics: 40 per cent use nipple shield and balsam of Peru or compound tincture of benzoin; 13 per cent stop nursing; 10 per cent have no routine; 10 per cent use bismuth or boric acid in castor oil; 10 per cent use silver nitrate and stop nursing; 10 per cent use silver nitrate and nipple shield; 7 per cent, use the glass nipple shield and cleanliness.

8, d How do you treat retracted nipples?

Michael Reese Hospital: Glass nursing shield, breast pump.

Other clinics: 26 per cent use manipulation and massage for retracted nipples; 26 per cent combine massage and manipulation with the breast pump; 20 per cent use nipple shield; 14 per cent use manipulation or massage and nipple shield and breast pump; 7 per cent use manipulation and nipple shield; 7 per cent use nothing.

9. Have you a special procedure at the time of the incoming of the milk, for the control of the breast congestion and the pain?

Michael Reese Hospital: Restriction of fluids, ice-bag, purge for undue congestion.

Other clinics: 30 per cent use nothing for breast congestion and pain; 17 per cent use binder and ice-bag; 12 per cent use catharsis; 12 per cent use binder and restricted fluids; 10 per cent use catharsis and restricted fluids; 10 per cent use binder; 3 per cent use heat; 3 per cent use massage; 3 per cent use breast pump; 3 per cent use breast pump and restricted fluids.

10. How do you treat a lump in the breast in the absence of fever?

Michael Reese Hospital: Apply baby to nipple varying its position to change its grasp of the nipple, occasionally peripheral massage directed toward the axilla.

Other clinics: 27 per cent do nothing for lump in breast in the absence of fever; 24 per cent continue nursing and apply ice-bag; 12 per cent use massage and binder; 10 per cent rest breast and apply ice; 7 per cent use massage and heat; 7 per cent use catharsis and ice-bags; 3 per cent pump the breasts; 3 per cent use antiphlogistine.

11. What do you do if a patient has a chill, fever, a painful spot, and leucocytosis?

Michael Reese Hospital: Stop nursing, empty *both* breasts and bind, moisten affected breast with bichloride of mercury 1:6000, apply continuous ice-bag, restrict fluids and purge. Binder is not removed until temperature is normal for 24 hours (at which time baby is again allowed to nurse) or until abscess is inevitable.

Other clinics: 27 per cent use ice-bag and binder and incision and drainage if necessary; 24 per cent use ice-bag and binder, and stop all nursing; 10 per cent stop nursing, use breast pump and catharsis and heat; 10 per cent use ice only; 7 per cent continue nursing and give catharsis and restricted fluids.

12. What has been your percentage of breast abscesses occurring in the maternity or shortly after leaving?

Michael Reese Hospital: January 1, 1917, to October 1, 1918: Service cases 0.26 per cent; staff private, none; outside private, 0.42 per cent; average, 0.23 per cent. October 1, 1918, to December 1, 1919, service cases, 0.71 per cent; staff private, 2.48 per cent; outside private, 2.04 per cent; average, 1.74 per cent.

Other clinics: 24 per cent reported no breast abscesses; 76 per cent reported an average of 0.79 per cent while in the hospital and 0.63 per cent soon after leaving.

13. Have you noticed increase in the percentage of breast abscesses since the influenza epidemic which began in September, 1918, and to what extent?

Michael Reese Hospital: Yes, in all classes of cases. The increase in service cases was 0.45 per cent, in staff private cases 2.48 per cent, and in outside private cases 1.62 per cent, making a total average of 1.51 per cent increase.

Other clinics: 94 per cent have noticed no increase since the influenza epidemic; 3 per cent have doubled the number of cases; 3 per cent noticed an increase.

14. Has this increase, if any, been chiefly or entirely among patients who had influenza during their pregnancy?

Michael Reese Hospital: Yes, four had influenza during their pregnancy, two suffered with bad "colds" and one was living with her husband while he was suffering with influenza, making a total of 7 cases. Six gave a negative history as to the influenza and 5 could not be located.

Other clinics: 100 per cent noticed no relationship to influenza; of these 48 per cent failed to answer this question; 28 per cent said "no," and 24 per cent noticed "no relationship."

15. Have you noticed a lower leucocytosis in the past year, in the mastitis cases, suppurative and non-suppurative?

Michael Reese Hospital: No.

Other clinics: 97 per cent noticed no drop in leucocyte count; 3 per cent noticed a drop.

16. What organisms have you found to predominate?

Michael Reese Hospital: Staphylococcus aureus and albus.

Other clinics: 43 per cent do not report type of organism; 37 per cent report staphylococcus only; 20 per cent report staphylococcus and streptococcus.

17. What is your usual surgical procedure in the presence of abscess?

Michael Reese Hospital: Radial incision, daily gauze packing until red granulations appear, then compression sponge.

Other clinics: 83 per cent use free incision and drainage as treatment of breast abscesses; 14 per cent "transfer to surgical department"; 3 per cent, no report.

18, a. How do you suppress breast function in cases of stillbirths?

Michael Reese Hospital: Breast binder, restriction of fluids, purge.

Other clinics: 54 per cent use binder, catharsis, ice, and restrict fluids; 24 per cent, binder only; 12 per cent, binder and catharsis; 7 per cent, nothing; 3 per cent, camphor and pressure.

18, b. How do you suppress breast function in case of death or removal of baby after nursing has been well established?

Michael Reese Hospital: Same as above, but first empty breasts and pump if necessary.

Other clinics: 54 per cent use binder, catharsis, ice, and restrict fluids; 18 per cent use binder; 14 per cent use binder and sedative; 7 per cent use nothing; 7 per cent use binder and camphor.

It will be seen from a study of the answers which have been received from the various clinics that certain routine procedures have won almost universal recognition, such as the establishment of a prenatal clinic, specific attention to nipples in clinic, some type of breast binder or support, a sterile protective covering for the nipple, boric acid cleansing of nipples before and after nursing, and lastly, in the presence of suppuration, free incision and drainage.

The greatest diversity of opinion is found in those conditions in which prophylactic treatment is most imperative, *i.e.*, the treatment of pathologic nipples, of breast congestions, lymphangitides, and threatened abscesses. Possibly a study of the table appended will serve to unify the kind of treatment in a particular condition.

It will be noted in the table that clinics 15 and 25 reported no breast abscesses yet gave predominating types of organisms found.

Clinics 4 and 19, show a decided increase in breast abscesses in the maternity or shortly after leaving as before 1918 and 1919, yet answer "no" to question "Have you noticed an increase in breast abscesses since the influenza epidemic which began in September, 1919?"

Clinic 4, answering question "Has there been an increase in breast abscesses among influenza patients?" states "no," yet answers "yes" to question "Has there been a lower leucocytosis noted in breast abscesses occurring during the influenza period?"

One of the writers and a staff colleague have each had the experience while visiting maternity clinics elsewhere of being assured in good faith that they have no breast abscesses, and then inadvertently stumbling on an actual case.

There seems to be a tendency to gloss over such cases, apparently because of an implied guilty responsibility. We have no such reluctance for we know the care with which our technique is conducted and controlled and we recognize the hæmatogenous and lymphatic origin of abscess to be very real. Among the details of technique may be mentioned throat and nasal cultures on each pupil nurse or interne just before coming on the maternity floor; removal from the floor, of interne, nurse, maid, or workman found to have suppuration; treatment of minor infections of patients, *i.e.*, paronychia, etc., by interne from gynecological service, etc.

SUMMARY

The influenza epidemics of 1918–1919 were largely responsible for the increase in breast infections following them, in the Michael Reese Maternity.

The technique employed in the Michael Reese Maternity conforms closely to that used in most of the clinics analyzed. These procedures were not varied during the periods of increased incidence of infection. This tends to confirm our view that the increase was in relation to the influenza waves.

We believe it would be advantageous for the largest possible number of clinics to adopt a uni-

form procedure for the prophylactic treatment of pathological nipples, breast lymphangitis, and threatened abscess, preferably that favored by the largest group in each case.

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PERINEORRHAPHY FOR COMPLETE LACERATION[1]

By THOMAS J. WATKINS, M.D., F.A.C.S., Chicago

In this paper I will attempt to review some important developments in the treatment of complete laceration of the perineum and will endeavor to demonstrate that perineorrhaphy for complete laceration has been perfected to the extent that a satisfactory result is almost certain to be obtained, that the technique is relatively simple, and that the patient should suffer very little distress after operation.

J. Collins Warren published a description of "a flap" operation for complete tear of the perineum in the *Boston Medical Journal*, in 1875. He later described this operation in a paper presented before the American Gynecological Society in 1882[2]. Figure 1 illustrates his method of forming the flap and Figure 2, his method of suture. He disposed of the flap by doubling it upon itself and reported satisfactory results. The special advantages gained were that the rectal mucosa was eliminated from the field of operation and the danger of a rectovaginal fistula occurring was lessened.

George Noble[3] in 1902 described an operation which displaced the upper part of the tear to the level of the skin and thus made the occurrence of a rectovaginal fistula following operation impossible. This was accomplished by separating

[2] Tr. Am. Gynec. Soc., 1882, vii, 322.

[3] Ibid., 1902.

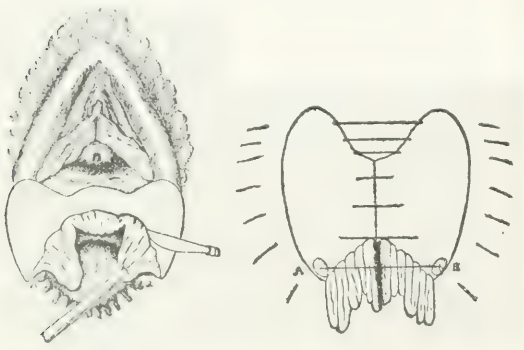


Fig. 1*. Collins' method of forming flap.
Fig. 2*. Collins' method of suturing flap.

* From Transactions American Gynecological Society.

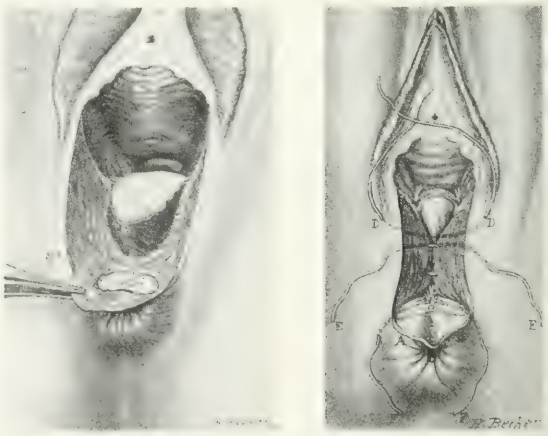


Fig. 3. The torn ends of the sphincter are freed and united by suture. (Kelly.)
Fig. 4. The flap is turned downward over the anus and the wound is partly closed. (Kelly.)

[1] Read before the Chicago Gyneeological Society November 19, 1920. For discussion see p. 379.)

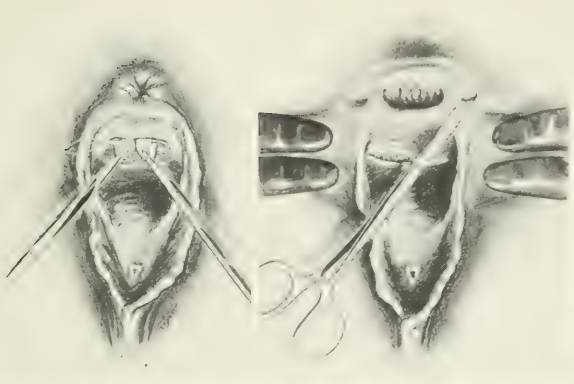


Fig. 5. Fig. 6.

Fig. 5. A transverse incision is made through the vaginal wall some distance above the tear. The torn ends of the muscle are exposed by blunt dissection with the scissors.

Fig. 6. All the tissue between the torn ends of the muscle is separated by blunt dissection down to the rectal mucosa.

Fig. 7. Fig. 8.

Fig. 7. The torn ends of the muscle is grasped on either side with an Allis forceps and elevated into the wound.

Fig. 8. Individual suture of the sphincter muscle is made.

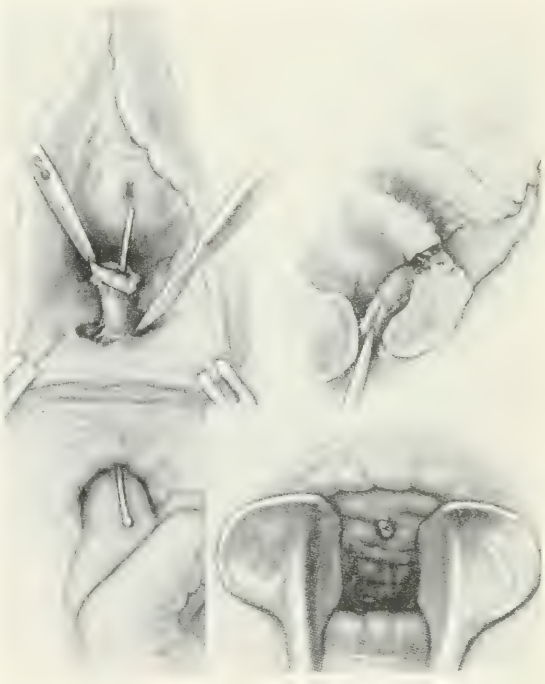
the rectum from the vagina by circular incision and blunt dissection so as to free the rectal wall and to displace the upper part of the tear down to the level of the skin. The rectum was sufficiently separated from the vagina to permit it to be displaced without tension.

Dr. Howard Kelly[1] describes a flap operation and individual suture of the sphincter muscle, and disposes of the flap by folding it upon itself transversely (Fig. 3). Dr. Kelly called attention to the necessity of making a fleshy flap to lessen the danger of sloughing. Kelly's operation accomplished repair without suture of the rectum. Individual suture of the muscle was initiated.

Figures 5, 6, 7, and 8 illustrate features in the development of perineorrhaphy for complete tear which was presented before this society by me some years ago. The flap was made sufficiently high so that all sutures when placed were a considerable distance away from the anus and thus minimized the danger of fæcal contamination.

Figure 6 shows the method of exposing the muscle by means of blunt dissection with the Mayo scissors. Figure 5 shows how all the tissues between the free ends of the sphincter are separated down to the rectal mucosa to facilitate approximation of the muscle. Figure 7 illustrates how the muscle is grasped with an Allis forceps and elevated into the wound. Figure 8 illustrates the torn ends of the sphincter muscle in approximation. The separation of the vagina from the rectum was made by blunt dissection after the method described by Noble, so that the upper part of the torn rectum was displaced down to the skin level. The flap was incorporated into the

[1]Kelly. Operative Gynecology, 1906, i, 288-89.



a. *c.*

Fig. 9*. *a.* The fistula is dissected free down to the rectal mucosa. *b.* The fistula is inverted into the rectum. *c.* Rectal exposure. The freed fistulous tract is ligated and the redundant tissue excised.

* From Surgical Clinics of Chicago.

Fig. 10. Fig. 11. Fig. 12.

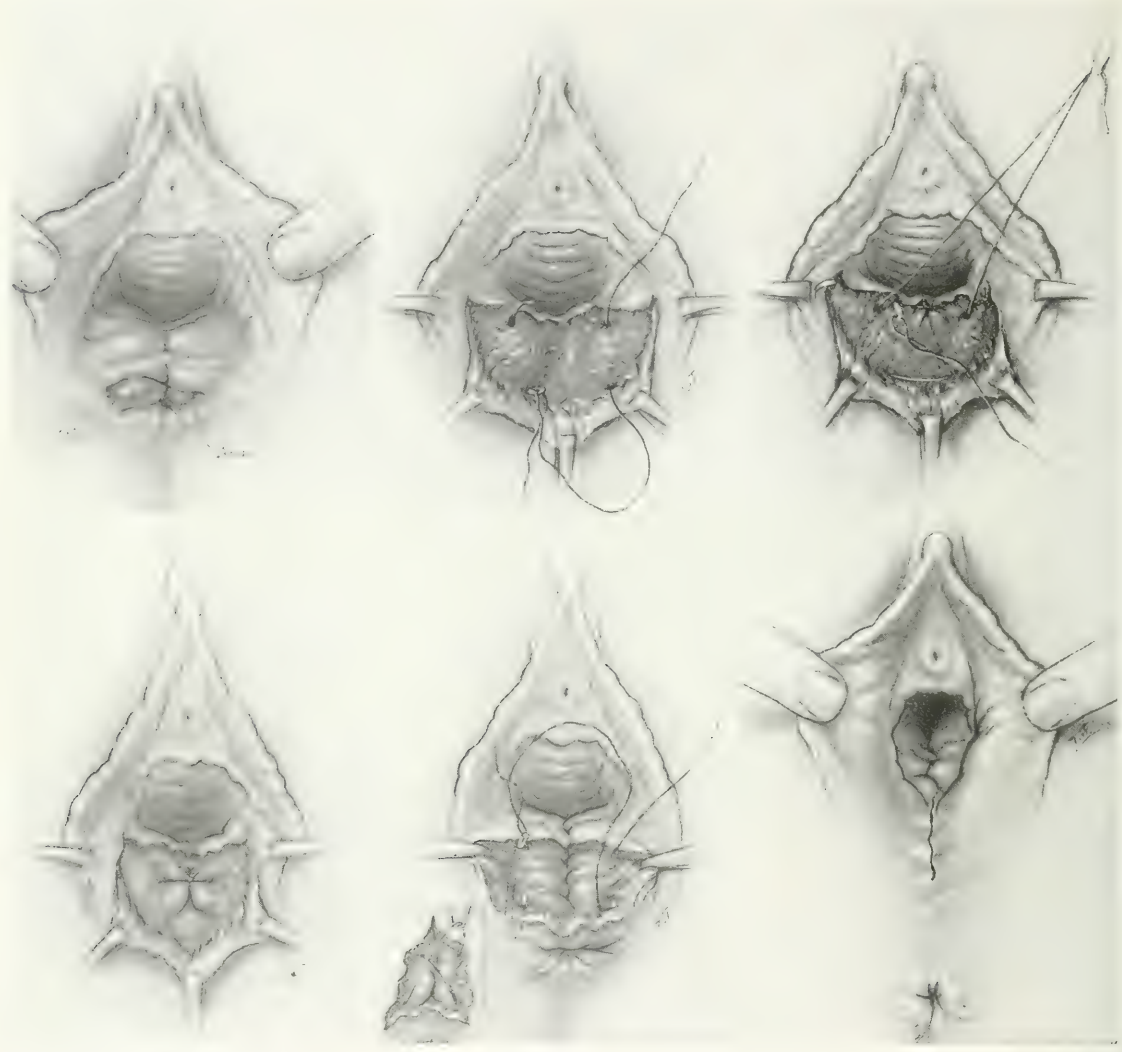


Fig. 13. Fig. 14. Fig. 15.

Fig. 10. Drawn from life.

Fig. 11. Shows flap made. No tissue has been removed. Suture passed through levator muscle and fascia deeply enough to grasp separated ends of torn levator ani muscle.

Fig. 12. Two subcutaneous sutures have been inserted and tied and a third is being placed to close upper part of wound.

Fig. 13. Appearance of wound after the sutures described have been tied.

Fig. 14. A second circular suture is being introduced. Note inclusion of sphincter ani by needle.

Fig. 15. Submucous and subcutaneous suture completes closure. Note the distance of the wound from the anal aperture.

wound by successively including a part of it in the sutures after the method employed by Tait[1] in his flap-splitting operation.

Figure 9, *a*, *b*, *c*, illustrates an operation described by Vernon C. David[2] in the *Surgical Clinics of Chicago* in a clinic on rectovaginal fistula. The illustrations show how the fistulous tract is dissected free down to the rectal mucosa, is then inverted into the rectum, ligated, and excised. This operation is an efficient and simple procedure for the cure of rectovaginal fistula and can be utilized to great advantage in the treatment

[1]Tait. Diseases of Women and Abdominal Surgery, vol, i, p. 68.
[2]David, V. C. Surg. Clinics. Chicago, 1919, iii, 1439.

of cases of injury of the sphincter ani muscle complicated by rectovaginal fistula. The operative principle is such as to offer a certainty of cure of the fistula. It eliminates the necessity of the usual procedure of cutting through the perineum down to the fistula in treating such cases and thus will often conserve a large amount of important tissue, will increase the proportion of desirable results, and lessen considerably the postoperative disturbances of the patient. In cases where there is not sufficient tissue to invert and ligate, the freed tract can be purse-stringed in the vagina and the purse string can be pulled through the opening into the rectum and tied. By utilizing a purse-string in this manner and by making a considerable vaginal flap when needed, a rectovaginal fistula of considerable size can be efficiently repaired.

Figures 10 to 15 illustrate a perineorrhaphy for complete tear which I now practice. The illustrations are exact reproductions of drawings made at the time of repair of the laceration shown in Figure 10. Figure 11 shows the flap formed and the tissues separated down to the rectal mucosa and the suture passed deeply through both ends of the torn muscle. Figure 12 shows the suture which has been passed through the torn muscle on either side and held by a forceps. A second suture is being introduced which includes the torn part of the levator ani muscle and its fascia at the upper part of the wound. Figure 13 shows these two sutures tied and the ends cut. Figure 14 shows a continuation of the closure of the wound, Figure 15 shows the perineorrhaphy completed.

The features which we believe to be important are:

1. The flap is formed so that the sutures are a considerable distance from the anus. The flap is fleshy, especially at the sides, so as to lessen the dangers of sloughing. All tissues between the muscles are separated down to the rectal mucosa so as to facilitate approximation of the severed ends of the sphincter muscle. Separation of the rectal from the vaginal mucosa is extended sufficiently to permit the upper part of the rectal tear to be displaced down to the skin level, as advocated by Noble. The flap is incorporated into the wound by passing circular sutures so that part of the flap is successively included, a procedure which Tait developed in his flap-splitting operation for complete tears.

2. The torn sphincter muscle is not dissected free and sutured individually. After considerable experience I became convinced that it was undesirable to do this because the freed muscle is not desirable tissue for suture. The sutures either cut through the muscle or cause atrophy and the muscle is considerably injured by dissecting it out and by pulling it into the wound. We believe that by allowing the scar tissue to remain over the torn ends of the muscle that much better tissue is obtained for suture, as all muscle to muscle union is a connective-tissue union and the presence of a little more or less scar tissue is of relatively small importance. The sphincter muscle is anatomically so closely incorporated in the levator ani muscle that it can be sutured advantageously with the levator ani muscle and fascia.

RESULTS

The danger of rectovaginal fistula resulting, which has always been a prevalent one without the flap operation, is eliminated. The muscular control is certain if the sutures include the sphincter muscle and if primary union results. With moderate care good muscular control should be obtained. The danger of constriction at the anus which always obtained where the rectal mucosa was sutured separately, is eliminated by the flap operation. Contamination of the wound from fæces is no more liable to occur than in perineorrhaphies for incomplete tear. Postoperative distress should not be much more than in simple perineorrhaphy if the tissues are approximated without much tension. Postoperative attention to the bowel is the same as after simple perineorrhaphy.

SCOLIOSIS

By S. KLEINBERG, M.D., F.A.C.S., New York

DURING the past few years there has been a relapse of indifference regarding the treatment of structural scoliosis. This is due, I believe, not so much to helplessness as to disappointment at the failure of certain proposed methods. The reader will recall that in 1911 and 1912 it was proposed that forcible correction for scoliosis should be applied with the trunk flexed. It was claimed that when the trunk is flexed the vertebræ are unlocked and can be rotated and displaced, and hence a curve of the spine can be readily straightened in this position. The theory was plausible, the method very complicated and seemingly effective, and the pictures of so-called corrected scolioses fascinating. There had been in addition such a long period of indifference and the embarrassment of the lack of "something new" in the line of treatment had reached such a marked degree, that most men were in a receptive mood for a new method. The proposed treatment of the scoliotic in flexion was, therefore, received with eagerness and enthusiasm and was rapidly put to the test on a very extensive scale throughout this country.

The enthusiasm for a while led most of us to believe that the presence of bulging ribs where there used to be a hollow indicated a cure or a close approach to a cure. We paid no attention to the patient, the greatly distorted appearance, the presence of extensive pressure sores, the malformation of the chest — for these were all incidental and were sacrifices made to obtain a straight back. Soon, however, we learned that the appearance of the back and chest was deceptive, for the curve of the spine was not straightened and seeming improvements disappeared almost completely, soon after the supporting jacket was removed. Gradually we discarded this, the Abbott method, and sought another.

It seemed to us that our first duty was to use some method that would at least not make the patient look worse and that would be attended with the minimum of discomfort. We decided to proceed slowly, to change jackets often and not to impose additional deformity by using awkward postures, pressure pads, etc. It soon became apparent that the safest as well as the simplest method was the old treatment with the spine in extension. We learned, however, that its effectiveness depended to a large measure upon continuity of treatment, and that it was poor practice to relax the spine from the new and corrected attitude and thus interrupt treatment during the time when a jacket was removed and the patient prepared for a new plaster.

At first, at the suggestion of Dr. Whitman, the treatment was carried out with the spine hyperextended, the arm on the "hollow side" abducted to a right angle or even raised to the vertical position and the chest rotated toward the side of the convexity. The rotation of the chest *toward the side of the convexity* resulted from pulling the "high" shoulder downward and backward. It was accidental in this treatment but is, I believe, of some importance. This method was not very uncomfortable and gave a certain degree of correction. Considerable difficulty was, however, encountered on account of the numbness and weakness of the elevated arm. Finally we adopted a slightly different method which we will presently describe, and which, used in a fairly large number of patients, has given very encouraging results. The most gratifying of our experiences with this method is that in the majority of cases—60 to 70 per cent, excluding thus only the razor-backs, severe kyphoscolioses, and cervicodorsal curves — we can surely prevent the deformity from getting worse and can with reasonable certainty predict marked improvement.

PREVENTION OF SEVERE GRADES OF SCOLIOSIS

The opportunity of preventing a given deformity from progressing is of paramount importance, for it means that under ideal conditions, namely, early recognition of the deformity and prolonged and continued treatment, we can eliminate the severer grades of curvature of the spine. The great obstacle we encounter in the effective control of scoliosis is the tendency to delay or interrupt treatment until the deformity has advanced to the severe grade. So many excuses arise. The weather is too hot; the cast will be heavy; my girl is preparing for graduation; we will send her to the country to get stronger; let us try exercises first. These and a thousand others are offered to us and only too often the physician acquiesces to the detriment of the patient.

Our chief concern for the present is to prevent the scoliotic deformity from getting worse. We try to improve it if we can. There is no known

method that enables us to *cure* a structural scoliosis. If, therefore, the scoliotic *comes* for treatment when the deformity is mild and we can keep it mild, we shall have scored a distinct success. But to prevent the occurrence of severe grades of scoliosis, the curvature must not only be recognized early, but immediate *corrective* treatment must be instituted and continued for years without interruption. No case of structural scoliosis, even a mild one, can be successfully managed unless the treatment and observation are continued for at least 5 years — and often much longer. This fact must not only be borne in mind by the physician, but impressed upon the patient or her guardian. We have frequently ourselves to blame for poor results. When we have applied a dozen or fifteen jackets to a patient during a period of 2 years, the patient, her parents, or often the doctor, begin to wonder when the process of changing jackets is going to end. Some one suggests an interruption for a week to see what results the jackets have wrought. This is a dangerous period, for when jackets are once discontinued, the patient is disinclined to renew wearing them. The patient frequently at this time takes occasion to consult other physicians; and not only is the period lengthened beyond what had been intended but an inexperienced physician may be consulted and unintentionally cause permanent interruption of the treatment. Thus the patient within a short time may lose what it had taken months to accomplish.

Fig. 1 (at left). Right dorsal scoliosis showing lateral deviation.

Fig. 2. Right dorsal scoliosis showing rotation and backward projection of ribs on right side.

PROGNOSIS

We all know that scoliotic deformities frequently advance to a terribly severe degree. We all know how distorted and misshapen are the patients with so-called razor-backs. Yet all these deformities were at one time very mild. How fortunate it would be for these patients if their deformities could have been arrested in their progress and kept mild. It would be a real accomplishment. To be sure in some instances the deformity stays mild. But we are not in a position to say which cases will stay mild and which will progress. We must assume, in the light of our present knowledge, that in any given case the deformity unless it has been stationary for a number of years, may get worse. We saw only last week two adults with advancing scoliotic deformity. Our experience has shown that a case of rigid scoliosis will not improve without treatment. This observation is a sufficient reason for instituting treatment as soon as the diagnosis is established. Without treatment, therefore, the prognosis is very poor. The deformity will neither disappear nor improve of its own accord and may at any time become worse.

In this connection it is well to consider gymnastic exercises as a corrective agent of rigid scoliosis. To be corrective, exercises must have selective and definitely limited action in order to cause untwisting of the spine. That is not possible, for a given movement of the trunk and body involves practically all of the muscles of the back and not a few isolated muscles or a single group of muscles which could exert a selective action. Moreover, a muscle acts in co-ordination with and not to the exclusion of all other muscles. By constant exercise the patient may, to be sure, learn to assume an improved posture and the curve may momentarily appear improved. That, however, is the limit of accomplishment. The child being treated by exercises must not be judged by her appearance in the gymnasium but by her postures at home and in school.

Treatment by exercises alone may even be harmful for (1) mobilizing the spine may afford an opportunity for the curve to grow worse and (2) the patient and her guardian believing the exercises to be curative rest undisturbed until much valuable time has been lost. From the patient's point of view treatment by exercises

is the method of choice. It is, however, only after a year or more has passed in this treatment and the deformity has become noticeably worse that the confidence in exercises is shaken and additional advice is sought. We know many patients who have gone through this experience.

Gymnastic exercises of whatever kind cannot, in my opinion, correct a structural scoliosis — a deformity the correction of which involves change of the structure and relationship of bones, muscles and ligaments. And why should we expect exercises to be corrective? Treatment by exercises consists merely in drilling the patient for an hour a day or every other day in different forced poses and postures. What series of postures, each one of which is maintained for a minute or two, can change the morphology and architecture of a vertebra, the attachment of a muscle, or the structure of a ligament? When viewed in this light, gymnastic exercises must necessarily appear ineffective as a really corrective treatment. The pity of it all is that because a case is considered mild, exercises are thought sufficient. It is just at this time that corrective treatment would be most beneficial. The loss of this favorable period is a great detriment in the progress of our work in scoliosis. The point I desire to emphasize is that *active corrective treatment* should be instituted just as soon as the diagnosis of structural scoliosis is made.

The diagnosis of scoliosis can and should be made early. The most effective preventive work can be done in the schools through the early recognition of the deformity. Not only should proper precautions be taken by the school authorities to install the most approved desks and seats, to see that the children maintain proper postures during their work, to give them appropriate periods of exercise and recreation, etc., but each child between 6 and 15 years of age should have its *naked* back examined at least once a month. It takes a trained eye but a few seconds to recognize a curvature of the spine and very many children can be examined in a short period. In this way cases of scoliosis would be discovered in their incipient stage and by treatment would be kept mild.

PRINCIPLES GOVERNING THE CORRECTIVE TREATMENT OF STRUCTURAL SCOLIOSIS

Although all the tissues of the trunk are involved in structural scoliosis, we are concerned chiefly about the condition of the spine, for no real improvement can take place without definite change in the shape and structure of the vertebræ and spinal column. The position and curve of the spine is, therefore, an index of any change in the deformity.

While we are greatly in doubt as to the exact primary cause of scoliosis, there is no doubt that the force of gravity is at least an important factor in maintaining and even increasing the deformity. In all except the most extreme cases suspension and elimination of the force of gravity are sufficient to reduce the scoliosis. We have seen repeatedly cases show marked reduction of the curve of the spine when the patient is in the prone or supine position, and very marked distortion and aggravation of the curve in the sitting or standing position. This is especially true of paralytic curves. We must, therefore, use some apparatus, usually a plaster-of-Paris jacket, to support the trunk and eliminate as far as possible the force of gravity as a factor operating on the deformed vertebrae.

The tissues on the hollow side of a curve are contracted, those on the convex side are stretched and enlarged. This is true of the muscles, the ligaments, and the bones. To correct the curve we must alter the structure and shape of the tissues. In some deformities such as bow-legs and knock-knees the parts involved are accessible and by manipulation or operation their conformation can be changed and the deformity corrected. In scoliosis, on the other hand, the important structures, namely, the vertebræ and the muscles and ligaments attached to them are inaccessible and therefore they can be influenced only by indirect methods.

We know that the structure of tissue, especially bone, depends upon its function and that change in function will result in change of structure. We take advantage of this principle of adaptability in the treatment of scoliosis. In a curvature of the spine the weight of the head and trunk comes chiefly on the side of the vertebræ toward the concavity. The vertebræ are thickened on the concave side and rarefied on the convex side. This is readily seen in a cross-section of a wedge-vertebra. To change the structure of the vertebræ, their function must be altered. If we can shift the center of gravity and the line of weight of the trunk so that it falls equally on the different parts of the vertebræ, or preferably on the convex side of the vertebræ, the function and hence the structure of the vertebræ will be changed. To accomplish this we place the patient in an attitude directly opposite to that of the deformity, thus stretching the contracted parts, relaxing the stretched tissues, and shifting the line of weight bearing. In a right dorsal curve, for example, the right

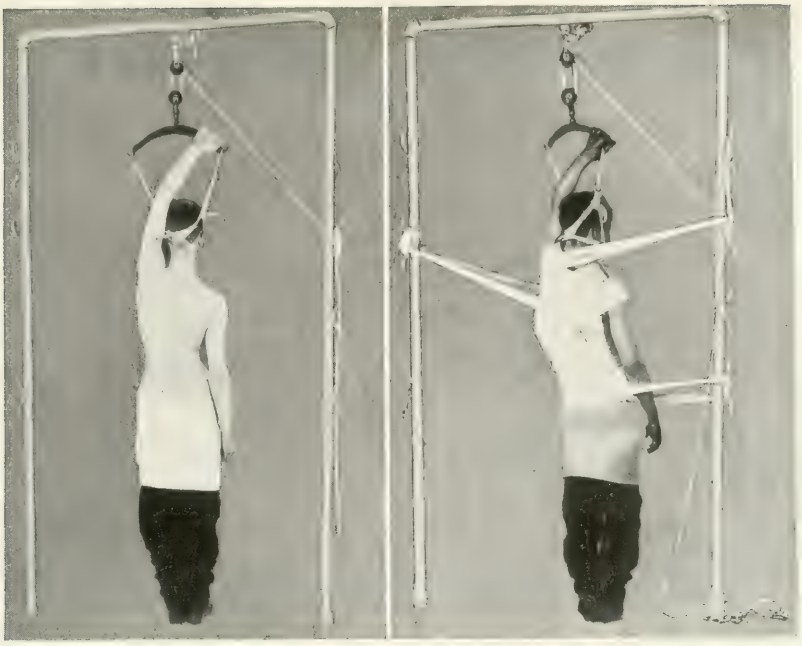


Fig. 3 (at left). Correction of curve under suspension.
Fig. 4. Position of trunk and limbs, number of traction bands, and direction of pulls.

shoulder is high, the left shoulder is low, the tissues on the right side of the dorsal spine are stretched while those on the left side are contracted, and the weight of the trunk is borne chiefly by the left halves of the vertebræ. If the patient is placed in a position in which the left shoulder is high and the right shoulder is low, and the trunk shifted to the left, the tissues on the left side of the spine will be stretched, those on the right side relaxed, and the center of gravity will be shifted to the right, so that the line of weight bearing will fall upon the middle of the vertebral bodies or nearer the right than the left border of the vertebral bodies. As a consequence the function of the vertebræ is changed, and in time their structure will be altered. Of course, change in function must operate for some time to effect a change in morphology. From the preceding observations we may conclude that the second principle governing the treatment of scoliosis depends upon a change in the posture of the patient in a direction opposite to that of the deformity.

Lastly, the spine may be likened to a bent rod which is straightened by holding its extremities and pressing on the most curved portion. In scoliosis, the extremities of the spine, namely the pelvic and shoulder girdles are fixed, and corrective force is applied at the site of the greatest convexity.

The principles observed in the treatment of rigid scoliosis are, therefore, the following:

1. Support of the trunk by an apparatus, usually a plaster-of-Paris jacket.
2. Change of the patient's posture to one directly opposite to that of the deformity.
3. Fixation of the pelvis and shoulders, and application of corrective force over the convexities.

The above principles are followed practically universally in the treatment of scoliosis. We may argue at great length as to the exact mechanism of production of scoliosis; we may argue at still greater length as to the value of the different elements of our favorite treatment; but we are all agreed that to straighten a curved spine it is necessary to immobilize the pelvis and shoulders and to apply pressure over the convexities. In the ultimate analysis all methods are alike in this respect.

CORRECTIVE TREATMENT

There has always been great difference of opinion in regard to the best position of the body for the application of corrective force. During the last 4 years the writer has used the extension

method exclusively. Taking a typical case of moderately severe right dorsal scoliosis, the procedure is as follows:

The patient having put on a seamless shirt, or preferably two shirts, is suspended in a Sayre head sling. At first she is pulled up so that she rests on her toes. After a few seconds she is asked to get down on her heels and if she has not been pulled up too high she can do so. If one waits now a minute or so, the patient can be pulled up farther and still remain on her heels. The more flexible the spine the farther can the patient be pulled up without raising the heels from the ground. Finally we get to a point where we cannot pull the patient up without raising her heels off the ground. If now we relax the pull just a little the patient is suspended to the maximum degree that will permit application of the jacket without intolerable discomfort. The position with the heels resting on the floor is important because the lumbar lordosis is reduced and the pelvis is in proper relation to the trunk, while if the patient rests on the toes the pelvis is frequently tilted forward abnormally. Suspension carried out as here described is sufficient in all but the severest cases to reduce the curve of the spine and improve the appearance of the back.

The left arm is then raised and the hand grasps the *right* side of the cross-bar. This stretches the left side of the chest and helps to increase the correction. The patient is encouraged to elevate and stretch the left arm as much as possible. This stretching may be increased by an assistant who grasps the arm and pulls it upward and to the *right*. A large removable pad of felt is then placed between the two shirts on the left or hollow side of the back. This pad is large enough to reach from the spine to the anterior axillary line and from just below the shoulder to about the second lumbar vertebra or termination of the dorsal curve. This pad must be fairly thick so that when it is inserted the back is symmetrical; or so that the left or padded side is a little higher than the right. At the periphery the pad thins down gradually so that the plaster passing over it on to the chest will not form a sharp ridge. When the jacket is completed this pad is removed and if it has been big enough there will be a large opening in the plaster to allow for expansion of the hollow side of the chest. The entire trunk is then thoroughly protected by several layers of thin felt, evenly applied. Extra padding is placed over the areas which will be subjected to considerable pressure. These are the convexity on the back, the crests of the iliac bones, the posterior part of the left shoulder, the anterior and upper aspects of the right shoulder, and the left side of the front of the chest.

If the patient is very sensitive or is troubled with any gastro-intestinal disturbances, it is well to insert a towel under the shirts over the abdomen. This is later removed and allows for distention of the abdomen without undue tension or distress. If the patient is a girl with well developed breasts, extra padding is placed over them. The pelvis is fixed by a traction band pulling to the right. In the same way the shoulders are fixed; this traction band inclines upward so that not only does it immobilize the shoulder girdle but in addition it pulls the left shoulder upward and aids in the correction. Another traction band of muslin or flannel is passed about the right side of the chest over the most prominent part of the convexity. This band is pulled to the left and is the main corrective traction band. To avoid undue pressure, an extra thickness of felt is placed over the convexity under this band. When these different bands are tightened, there is a further reduction of the deformity. The bands are pulled only as much as the patient can comfortably tolerate and not any more. If too much force is used, the patient is subjected to discomfort, which may lead to fainting and compel the operator to interrupt the plaster work when he is half way along or even almost done.

A word of caution in regard to tolerant, especially willing, and to paralytic patients. These patients may permit the use of a great deal of traction at the time the bands are being adjusted. It is well not to pull too much, for the pressure may become too great, and despite the forbearance of the patient, fainting or even shock may supervene. The right or high shoulder is pulled downward and backward by an assistant. This causes a rotation of the chest toward the convexity of the curve. The chest may be rotated almost 90°. Rotation of the chest toward the convex side of the curve was first suggested by Dr. A. Mackenzie Forbes, and without going into detailed study of the effect of this manœuvre, there is no doubt that it causes a decided reduction in the deviation of the spine. Theoretically it is argued that this twisting of the chest causes an enlargement or expansion of the contracted side (in our case the right side). Practically we find that whereas with the Abbott method the compressed side of the chest became more compressed with this method the transverse diameter of the contracted side remains as it is or becomes larger. Twisting of the chest toward the side of

the convexity is, therefore, an advantage because it is helpful in reducing both the deviation of the spine and the compression of the chest.

When these preparations are completed, the patient is in an improved attitude. She is from 1 to 2 inches taller. The spine feels straighter. The convexity is less marked. The hollow is distinctly reduced. The shoulders have been reversed in their relative position and the contracted side of the chest is wider.

We then begin the application of the plaster bandages. In order to make the jacket very strong and to reduce the time occupied in applying it, it is helpful to have an assistant prepare plaster pads or reverses to reinforce parts of the jacket that should be very strong. We first apply the plaster over the pelvis going fairly low down to the coccyx, rolling the plaster so that the jacket will fit very snugly about the pelvis. The jacket is completed in the ordinary way and includes the right shoulder. On the left side the plaster reaches to the spine of the scapula. In order to bring the right shoulder down as far as possible, the plaster bandages pass under the axilla, over the shoulder from behind forward, and then down over the right scapula toward the left iliac crest. In this way not only is the right shoulder depressed and held so without the aid of an assistant, but in addition the right scapula is rotated backward and the prominence of the angle of the scapula is reduced. Plaster pads or reverses are applied over the right shoulder, across the back of the left shoulder, over the convexities of the chest back and front, and across the back at the dorsolumbar junction. Just about the time the plaster is hardening it is molded over the convexity so that it may fit very accurately. When the plaster has hardened, it is trimmed in the usual way except that it is left on, over the right shoulder, and is cut as high as possible with comfort to the patient under the left shoulder. A large window is cut out of the plaster on the left side in back and the removable pad is taken out. This allows for expansion of the hollow side of the chest. If the plaster has been molded properly over the convexity, the right side of the chest will be restricted in its excursions, and respiration will cause increased mobility and consequent expansion of the hollow side of the chest. When the jacket is completed, it is asymmetrical, the left side being larger and longer.

An asymmetrical plaster jacket for scoliosis is different from the ordinary jacket, for instance, for Pott's disease. In the latter case, the jacket is applied with uniform pressure for efficient

Fig. 5 (at left). Corrective plaster jacket, back view.
Fig. 6. Corrective plaster jacket, front view.

support. In the former, the pressure is uneven. We desire extra pressure over the convexities back and front, over the right shoulder in a backward and downward direction, and in back of the left shoulder to hold it up high and keep it forward. These regions, as well as the dorsolumbar region must be reinforced, for a big window is to be cut out of the plaster. On the other hand, we do not desire any pressure over the abdomen or over the back on the left side, and here the plaster may be very thin. The plaster bandages are, therefore, rolled on with all these important points in mind.

When we are dealing with a double curve, let us say a right dorsal left lumbar curve, in which the lumbar curve is well marked, we utilize an extra traction band to pull the lumbar spine to the right. In addition we provide for correction of the lumbar deformity by inserting a removable pad on the right side of the lumbar region. This is removed through a window, cut over this section. If the front of the right side of the chest is markedly compressed, it is well to allow for its expansion by placing a removable pad over it. This pad must extend from the angles of the ribs over the lateral aspect of the chest to the sternum. It is not sufficient for this pad to be placed over the front of the right side of the chest, for the lateral compression of the chest begins and in fact is most marked near the angles of the ribs.

If the curve involves the upper dorsal or the cervicodorsal vertebræ, the plaster must include both shoulders and extend to the occipital protuberance in the back and the chin in front, *i.e.*, a Calot jacket.

A plaster jacket should be left on for from 1 to 2 months. More frequent changes are not advisable, for having stretched the back, we must allow sufficient time to elapse to permit the tissues to adjust themselves to their new position.

Formerly we used to use felt pressure pads and inserted them under the plaster over the convexities. These do perhaps increase the correction but they cause great discomfort and frequently pressure sores, and if the plaster has been applied properly, they are very difficult to insert sufficiently accurately to produce the desired result. It is, I believe, better to do without them and to depend upon the shape of the plaster to effect and maintain correction of the curvature. Considerable corrective influence may be gained by practicing forced breathing for 10 minutes every 2 hours in the "keynote" position. During these breathing exercises, the patient forces herself over to the left side by elevating the left arm as far as possible with the hand over the back of the neck and the head inclined to the right side.

The aim in applying a new jacket is to correct the spine a little more or hold the patient in a better position than in the preceding one. The interval between jackets is determined by the time it takes to fill in the jacket. That is, when the chest on the hollow side reaches the plaster and has no further room for expansion then it is time to change the jacket. Or, if at the end of 4 or 5 weeks the jacket is very loose, it must be replaced by a new one.

The patient is then suspended until she is resting lightly on her heels. The jacket is removed. The skin is washed and the patient is prepared for a new jacket. Additional suspension and traction are now applied and increased correction obtained. In this way we do not allow the tissues to relapse to their original condition. We keep whatever correction we have gained in the last jacket and add to it. On many occasions following the older procedures, it has been noticed that a second jacket did not improve the patient any more than, in fact sometimes not as much as, the first jacket; whereas if the patient is not allowed to relapse when a jacket is being changed, the second jacket almost always shows a gain in correction. The writer has become convinced of the efficacy of this detail in the treatment and recommends its adoption.

Ordinarily a patient, who has had a jacket applied with the spine in extension, is inconvenienced for only a few days. She soon accommodates herself to the new position and is able to continue with most of her daily routine. The writer has a fairly large number of patients treated with "straight" jackets who attend school regularly, take music lessons, etc. They hardly ever lose more than one day from school at the time a new jacket is applied, and the treatment is at no time unbearably uncomfortable.

In the treatment with the spine in extension, we seek with every jacket to place the patient in a posture in which the back appears improved as compared with its original condition. As a result of this, whether the patient is cured, improved, or not improved, we never make the patient look worse than he did before the treatment was begun.

CONCLUSIONS

The most effective means of recognizing scoliosis early is by regular frequent examinations of the naked backs of all school children.

Corrective treatment should be instituted as soon as the curvature of the spine is discovered.

Treatment should be carried on uninterruptedly for years until improvement has been obtained and until such time as will reasonably assure arrest of the deformity.

Treatment with the spine in extension is at present the best form of treatment for it enables us to arrest the progress of the deformity and in many instances to reduce the curvature. It is the least uncomfortable treatment and does not cause malformation of the chest. The essential feature of the treatment is keeping the patient in a position that is opposite to that of the deformity.

During change of jackets there must be no opportunity for relapse of the deformity.

PURULENT PERICARDITIS

A Closed Suction Technique for Drainage; Report of a Case

By WYMAN WHITTEMORE, M.D., F.A.C.S., Boston

UNFORTUNATELY, from the surgeon's point of view, cases of purulent pericarditis that come to operation are extremely uncommon. In 1900, C. B. Porter reported in *Annals of Surgery* for December, 51 cases of incision for pericarditis, collected from literature; 20 recovered and 31 died, a mortality of 60.5 per cent. During the last 32 years at the Massachusetts General Hospital, there have been only 2 cases operated on. The first was successfully operated upon by C. B. Porter in 1900, and the other is the case reported here.

The only operative proceedure that has been reported, or at least that I have been able to find in literature on this subject, is an open drainage technique, the details of the operations varying slightly according to the operator but the main factor being a resection of a portion of a rib cartilage and wide opening of the pericardium, drainage being taken care of by one or two large tubes. Practically all cases were irrigated with salt solution or some mild antiseptic solution.

In 1912 Boxwell in the *Dublin Journal of Medical Science*, for August, says: "A pericardial effusion requiring any surgical intervention at all ought to be treated by resection of a rib cartilage and free opening of the sac. . . . It is the only safe and satisfactory method." If one delays operation until there are masses of fibrin present then open drainage surely gives the patient his only chance, but I believe that operation should be done before masses of fibrin form. Furthermore, if one remembers that the patient is lying on his back in bed, the operation of resecting a rib cartilage and opening the pericardium is merely lifting the top off an abscess cavity and not making any effort to drain the abscess at its most dependant part. With a patient lying in bed the most dependant part of the pericardium is the posterior sulcus, which is situated half way between the apex and the base of the heart, and this is the most important region to drain. In this old classical operation, it seems probable to me, that in many cases this posterior sulcus was never drained. In pneumococcus infections of the pericardium, which are the most common that require surgery, masses of fibrin and adhesions rapidly form, so that, if this posterior sulcus is not drained it will soon become walled off from the anterior part of the pericardial cavity, which has been drained,

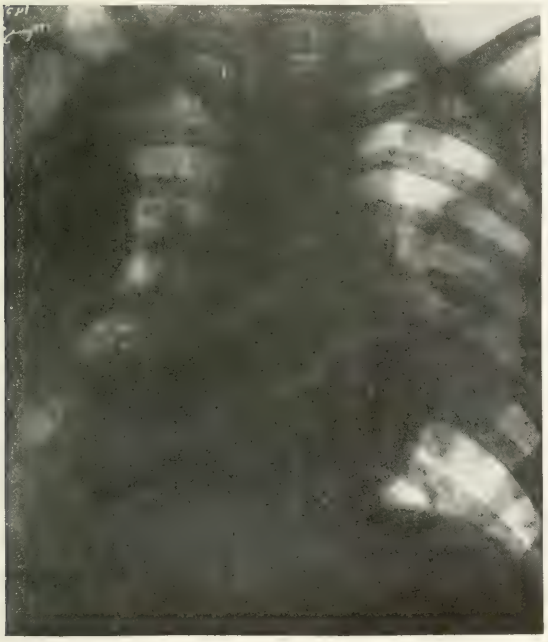


Fig. 1. Encapsulated empyema on left. Pneumonia on right. May 9, 1920.

Fig. 2. Tip of catheter draining most dependant part of encapsulated empyema. May 10, 1920.

Fig. 3. Heart shadow enormously increased. Empyema cavity empty. May 15, 1920.

and never drain at all and the patient will eventually die. I believe this has a great deal to do with the high mortality in these cases.

Believing that the posterior sulcus must be drained, the following technique was thought out. This was suggested to me by the closed suction technique that I have been using for several years in early cases of empyema. By this technique the posterior sulcus can be drained, the fluid can be emptied from the pericardial cavity slowly, which is probably important if there is a large amount, and furthermore no air is allowed to enter the pericardial cavity. I realize that we do not know just how much harm air in the pericardial cavity does, but it seems wise not to allow any to enter if it is possible to keep it out.

TECHNIQUE

Under local anæsthesia (novocaine ,1 per cent) an incision about three-fourths of an inch long is made in the fifth interspace, just inside the border of dullness. The muscles, pericardium, and pleura, if there is any, are anæsthetized. The pericardium is extremely sensitive, and it is necessary to use a considerable amount of novocaine. A long trocar with cannula large enough to admit a No. 10 French catheter is pushed through the pericardial wall. It is necessary to have a fairly sharp trocar and one must use considerable force in going through. One must use much more force than in going through the pleura. The pericardium will give in front of the trocar, the trocar tending to push it away rather than to go through it easily and therefore

Fig. 4. Heart shadow back to normal. Catheter draining pericardium in place, and catheter draining empyema in place. May 26, 1920.

one must use a sharp trocar. Having gotten into the cavity with the trocar, a No. 10 French catheter that has been shut off with a hæmostat is quickly slipped through the cannula. The catheter is then pushed in a long distance: far enough to allow the tip to go around the apex of the heart and then half way up to the base. In my case this was between 8 and 9 inches from the skin. The catheter is sewed in tightly. Suction is made with a large glass syringe and no air allowed to enter the pericardium at any time. The pus can be emptied out slowly. Suction is done every 1 to 2 hours for the first 24 hours and then every 2 hours until the amount obtained at each time is only 3 or 4 cubic centimeters. Then the time is lengthened to 3 or 4 hours and finally to twice only during the 24 hours. When the amount in 24 hours is only 1 to 2 cubic centimeters and this amount does not increase for 4 days, then the catheter is removed.

A boy, 12 years old, was seen May 8, 1920, in consultation with Dr. W. D. Smith of Boston and Dr. F. R. Clark of Newtonville. He had had an attack of measles of ordinary severity from which he was apparently convalescent with normal temperature. On April 27, the following day, he had a sudden chill and high temperature. The temperature had remained about 104°. The white count was 11,200 on the 29th and 27,200 on the 30th. Respiration was extremely limited, breathing shallow, movement

more restricted on the left. Examination showed in the left back from mid-scapula to base, marked dullness, increased whispered and tactile fremitus, loud bronchial breathing, crepitant râles. On May 3, there was severe pleuritic pain on left. The temperature was still about 104°. Examination showed flatness in lower back. May 8, there was flatness in left axilla and back with faint distant breath sounds and diminished tactile fremitus. A needle was inserted just below the angle of the left scapula and 4 cubic centimeters of straw-colored, turbid serum removed. The sediment showed an excess of leucocytes and many bacteria resembling streptococci. There were also signs of a pneumonia at the right base. May 9, patient was moved to the Massachusetts General Hospital where an X-ray was taken. X-ray (Fig. 1) showed an encapsulated empyema on the left, and a pneumonia on the right side. A closed suction operation was done under local anæsthesia (novocaine 1 per cent). A small amount of thin pus drained out during the first night and the next day irrigations with Dakin's solution were started and kept up every 2 hours until the empyema was well. Forty-eight hours after operation the left ear began to discharge pus and the right ear drum was bulging. This was opened without any anæsthetic by Dr. Tobey. X-ray (Fig. 2) taken the day after operation shows tip of catheter draining the most dependant part of empyema cavity. On May 15, his temperature was 100° to 102°, respirations 35, pulse 110, and he looked bad. X-ray (Fig. 3) showed the heart shadow enormously increased and the empyema cavity empty. Aspiration of the pericardium in the fifth interspace, just outside the nipple line and inside the border of dullness, gave thin pus showing under the microscope many leucocytes and a rare organism resembling the organism from the empyema. This organism was finally proved to be a pneumococcus type 1. Drainage of the pericardium was done by the technique already described. Twelve hundred cubic centimeter of pus was removed during the first 24 hours following operation. X-ray (Fig. 4) was taken 11 days after this operation. This shows the catheter in place with the tip draining the posterior sulcus and the heart shadow back to normal size. The amount of pus gradually diminished until at the end of 4 weeks, there was less than 2 cubic centimeters obtained each 24 hours and then the catheter was removed. The following day the drainage tube was removed from the empyema. Smear taken from both cavities showed less than 1 pneumococcus in 5 fields and a rare staphyloccocus. Both sinuses healed promptly and at the end of 8 weeks from the time he entered the hospital he was up walking about a little, with a temperature no higher than 99°. The following day the skin over both mastoids was found œdematous and immediate operation was done under ether, by Dr. Tobey. The patient stood the operation very well. He made an uneventful recovery. He left the hospital 3 weeks later with the wounds entirely healed.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held November 19, 1920, Dr. Arthur H. Curtis, Presiding

BASAL METABOLISM IN PREGNANT WOMEN

Dr. Joseph L. Baer: I have recently been studying basal metabolism in pregnant women in a series of cases and have had the privilege of determining the basal metabolic rate in a rather unusual case which I would like to report because of its possible diagnostic significance.

In general, the problem I am working on now consists in determining basal metabolic rate in normal pregnant women in the last 4 weeks of pregnancy and then again immediately after delivery, in an attempt to determine whether the difference in the two rates is greater than is accounted for by the loss in the woman's weight. Through the courtesy of Dr. Frankenthal, I was permitted to estimate the metabolic rate of a woman 36 weeks pregnant in whom a dead fœtus had been diagnosed 3 weeks before the time I saw her. Several estimates of her metabolic rate averaged 9 per cent plus. I then determined her metabolic rate shortly after delivery of this macerated fœtus, and it was exactly normal. In other words, this woman was near full term yet showed only an elevation in metabolic rate within the normal limit of error; that is, an error in the entire problem of 10 per cent plus or minus is permissible and may be ascribed to personal equation, variations in the machine, etc. Immediately after delivery she had a normal rate. What bearing that will have as a diagnostic measure in the determination of still-births remains to be seen, but it appeals to me as distinctly interesting.

Fig. 1. Case of Dr. Culbertson. Microscopic examination showed it to be simple fibroma.

Dr. Lester E. Frankenthal: It is best not to say anything this evening on the subject presented by Dr. Baer. I would rather wait until Dr. Baer is through with his observations, which, I assume, will take him another year.

The question I would like to hear answered by members of the society is as to how long a time they have known a dead fœtus to be carried in the uterus of a woman. In my patient, just referred to by Dr. Baer, the fœtus was dead more than 3 weeks to my positive knowledge.

Dr. Frank Cary: I have seen one case that went 2 months beyond full term.

Dr. Carey Culberton: In 1909 we had a case at the Presbyterian Hospital where the fœtus died at about the fifth month of pregnancy. The patient had missed nine or ten periods; she had felt life when she thought herself to be 5 months pregnant, after which all signs and symptoms ceased. Previous to entering the hospital she had been sick for 4 months with loss of appetite, malaise, headache, backache, and urinary frequency. Examination revealed a mass rising to the pelvic brim, representing an enlarged, soft, boggy uterus. The urine showed a large amount of albumin and numerous granular and epithelial casts. An intact gestation sac containing a dead fœtus of about the fifth month was removed from the uterus, the entire mass being soft and pultaceous. The patient was profoundly toxic and died 2 days later of acute nephritis.

Dr. Eugene Cary: I had a case in the clinic recently that had gone to the eleventh month of pregnancy so far as we could determine. The fœtus had not been alive since the seventh or eighth month, and before anything was done we lost track of her.

FIGURE-OF-EIGHT KNOT IN CORD

Dr. William C. Danforth: Last spring Dr. Davis showed two cases before the society of knots in cords, and I happened to have had one in the

laboratory which was a true figure-of-eight knot, the only one which I have ever seen.

I had a case the other day in which there was a figure-of-eight knot in the cord in an otherwise normal patient. The first case was perfectly normal except the baby was dead by reason of the knot having been drawn tight during delivery. The other case presented no difficulties whatever. The knot was quite loose when the child was born. Neither case had any hydramnion nor any abnormality during pregnancy.

FIBROID TUMOR COMPLICATED BY THE RUPTURE OF A VESSEL

Dr. Mark T. Goldstine: I wish to show a specimen of fibroid tumor which presented an unusual feature. The tumor was removed from an unmarried woman, 24 years of age. While scrubbing the floor about 9 o'clock one Monday morning, she suddenly became faint and slightly nauseated. She stood up, grew worse, and was compelled to lie down. About noon she called a physician. Her abdomen was greatly distended and quite rigid. The physician prescribed for her and returned at about 4 o'clock in the afternoon. As her condition was much worse he made a tentative diagnosis of rupture of the bowel. At 6 or 8 o'clock in the evening he had council. The patient was getting progressively worse, and I saw her at about midnight or a little later, at which time she was in profound shock; the hæmorrhage was so profuse that intervention was impossible at that time. She was taken to the hospital, and on Wednesday morning at 9 o'clock we opened the abdomen and found it filled with blood. We cleaned it out carefully; the only bleeding that I could find was due to a ruptured vessel on top of the fibroid. The woman rallied nicely from the operation, but unfortunately died suddenly on the fourth day.

Dr. Carey Culbertson: I have four fibroid tumors to show this evening. The first specimen is a large tumor removed from a patient 29 years of age, and is an excellent example of the old so-called "cystofibroma." The specimen is considerably smaller than it was when removed. It weighed 690 grams, was 66 centimeters in smaller circumference, and 79 centimeters in the longer circumference, and contained a thin bloody fluid which did not coagulate. Before operation the abdomen measured 33 inches in circumference at the umbilicus and 17 inches from the symphysis to the ensiform. The patient had never been pregnant and complained merely of abdominal tenderness which had come on gradually during the past 2 years. The pain was present in both the left and right iliac regions and at times was severe enough to cause the patient to go to bed. There was no menstrual disturbance. There had been some leucorrhœa for 18 months and some frequency of urination for the same period of time. Upon section of the tumor, a thin dark fluid escaped, while the greater substance of the interior was made up of a material which closely resembled porous red rubber. These spaces were separated by bands of darkly stained fibrous material representing a fibroid that had undergone red degeneration and in turn had changed to cystic formation. At the lower portion only was there a small area representing the original unchanged fibroid tumor.

This tumor was particularly interesting before operation because, being a cyst it closely resembled an ovarian cyst but on vaginal examination there were a number of points that made it recognizable as a fibroid in the pelvis.

The second specimen is another uterine fibroid that is interesting in comparison with the specimen shown by Dr. Goldstine. The patient was 39 years of age, and came into the hospital complaining of pain in the left iliac region, coming on suddenly one week previously, associated with nausea and vomiting. The pain was sharp and cramp-like, and especially severe on the left side. The patient thought that she had experienced a small painful swelling in the lower abdomen 4 months ago, but this had disappeared entirely until one week prior to admission when it again appeared with pain. There had been no menstrual disturbance except that the periods had been somewhat more profuse for the last 6 months; for 3 months there has been dysuria. Examination showed a tumor in the pelvis not rising above the plane of the inlet and filling the lower pelvis with a soft, boggy mass, so that the diagnosis rested between pelvic abscess, pelvic hæmatocele, and uterine fibroid. When the abdomen was opened the tumor projected a short distance above the plane of the inlet and the pelvis was filled with blood, partly clotted, partly thin, very much resembling that found in ectopic pregnancy. The anterior cul-de-sac was filled with a broken down material which at first glance appeared either to be malignant degeneration, or necrobiosis, that had broken down and had given rise to hæmorrhage. Microscopic section of this material showed it to be a sarcoma. The rest of the specimen is made up of a compound, conglomerate fibroid mass. One large nodule is soft, dark gray in color, with a cheesy area just beneath its capsule. The uterine cavity is small and the mucosa normal. A small sessile nodule is present at the internal os. The other nodules show no change.

The third specimen is from a patient 29 years of age who came into the hospital complaining of pain in the abdomen, the onset of which occurred last November and was severe enough to confine the patient to bed at that time for 3 weeks. Three weeks ago she suffered another severe attack, limited at this time to the left side, with some nausea but no emesis. This patient also has never been pregnant and has had no menstrual disturbance. There has been a vaginal discharge and dysuria dating back also to last November. The patient has experienced some febrile reaction, her temperature during her presence in the hospital not rising above 100.6°,

leucocytosis 8400, hæmoglobin 90 per cent. The lower abdomen was slightly distended by a mass which filled the left quadrant as high as the anterior superior spine, a mass tender and fixed. This also gave us some trouble in diagnosis, since ectopic pregnancy was suspected. Vaginal examination revealed only that the left pelvis was occupied by a mass which was firm, tender, fixed, and continuous with the mass in the abdomen. The specimen is a uterus enlarged by four small intramural fibroids, the cavity being 2½ inches deep with normal mucosa. The larger portion of the mass is a pedunculated fibroid attached to the fundus. It measures 12 by 5 centimeters, is soft, and has a gangrenous area at its upper pole. On section this contained 14 ounces of thin foul pus of colon bacillus odor. This infected nodule had become adherent to the omentum and transverse colon at the point where it was gangrenous. The sigmoid flexure was free but its appendices were infiltrated and adherent to the tumor.

The fourth specimen which I wish to show was presented through the courtesy of my associate at the Cook County Hospital, Dr. Channing W. Barrett. The patient is a young woman 25 years of age who entered the hospital because of a tumor projecting from the external genitalia, which according to her statement, had grown to its present size within the short period of one year. She complained of pain in the lower abdomen, ascribing it to this tumor. There had been some vaginal discharge for 8 years but no menstrual disturbances. The blood gave a Wasserman negative reaction. She had been married 2 years, and had had one miscarriage in the fourth month 6 years ago; no subsequent pregnancies. There was no urethral discharge, no inflammation of Bartholin's glands or of the inguinal glands. The tumor proved to be an involvement of the clitoris. As described before operation it appeared as a large pedunculated tumor arising originally from a pedicle at the clitoris, the size of a cantaloup, freely movable, painless not tender. The labia were thickened showing some erosion, covered with small mollusc-like growths which extended over the vestibule and about the vaginal introitus. The diagnosis lay between fibroma, elephantiasis, and malignancy. Microscopic section showed it to be a simple fibroma.

BREAST INFECTIONS

Dr. Joseph L. Baer and Dr. Ralph Reis presented a joint paper entitled "Breast Infections." (See p. 353.)

DISCUSSION

Dr. Carl Henry Davis, Milwaukee, Wisconsin: During my entire experience in private practice, I have had only four breast abscesses. Three of these have occurred within the last year, two in patients who had had mild influenzal attacks during their pregnancy. Both of these had the abscess develop about 4 weeks after leaving the hospital. Both of them made a slower convalescence than is usual while in the hospital. The third patient, and the only one that developed an abscess while under my care, was one who did not have the influenza but whose children had had influenza in a mild form. She was in a badly run down condition and made a slow convalescence.

In the one case that developed in the hospital, culture showed staphylococcus aureus. Cultures were not obtained from the other patients.

The treatment which we have used for the nipple is practically the same as that outlined by Dr. Baer.

I have been impressed with the number of patients in the last year and a half who have developed tender areas in the breast; where it has been necessary to keep the breasts supported and to use ice caps several times while in the hospital and again after leaving the hospital. With prompt treatment these tender areas usually disappear in a day or two. Whether there is any direct relation between influenza and the increase in the frequency of breast abscesses is doubtful. But inasmuch as it does lower resistance it may be a predisposing cause.

Dr. Arthur H. Curtis: May I ask how long after evidence of abscess do you wait before you allow the baby to go back to the breast?

Dr. Baer: We wait the normal time, about 24 hours or more.

Dr. David S. Hillis: We have three important items in our armamentarium in treating cases with cracked nipples: first, the glass nipple shield; second, the lead nipple shield, and third, the tea strainer. The most important thing to be accomplished is rest for the nipple. This is secured by the glass nipple shield, and in the more severe cases we should remove the baby from the breast entirely. I still adhere to an old method of treatment which is serviceable in some cases which are not so severe, that is, in tender nipples which are not cracked. Here I use a lead nipple shield, and if within 2 or 3 days the condition does not clear up, more energetic measures are necessary. In the very bad cases, with cracked nipples and erosion, absolute rest and the air treatment, which is accomplished with the aid of a tea strainer under the binder over the nipple.

With regard to abscess of the breast, I have a rather strong prejudice in favor of the use of ice, and I believe I have had enough experience in abscess of the breast to say that ice properly applied early enough and long enough is the most efficient means of preventing abscess formation in these cases. I think perhaps the reason that ice is not more generally used is because of the method of using it. I believe that ice should be applied next to the skin, and the nurses in practically all of our hospitals are taught to apply a dry towel or dry piece of gauze between the ice bag and skin, on account of a fear of frost bite. As to the question of frost bites from an ice bag, I have been looking for them for 10 years but have not found one. A frost bite might

occur with an ice bag next to the skin over the shin bone, but not in a part with a blood supply such as is found in the nursing breast. It seems to me the danger is not a real one. One of my head nurses came to me in great anxiety one day and stated she wanted to show me a frost bite where an ice bag had been applied next to the skin. I went into the ward and the frost bite which she had observed in the morning had disappeared entirely. I believe that practically every threatened abscess of the breast can be avoided if properly treated with ice.

Dr. Mark T. Goldstine: I am very much interested in this paper on the etiology of breast abscess, but I am not fully convinced that cases of breast abscess are due to lowered resistance on account of the influenza epidemic.

I have had more cases of breast abscess in the last 2 years than ever before, and I have been trying to search for the reason, and rather than attribute them to the influenza epidemic, I have more or less attributed them to the infection we have had among the babies, which was so-called impetigo contagiosa. The rash and blebs these babies showed contained staphylococci. I am inclined to think the increase in the number of breast abscesses is due more to contact infection from the babies than to lowered resistance from influenza infection, for the reason I have had a great many more breast abscesses since we have had that epidemic among the babies.

I have a woman now who has a small abscess in each breast. The abscess started in one of the mammary follicles in the form of a small furuncle, about an inch and a quarter from the nipple, the small abscess having developed beneath the subcutaneous tissue. I opened it and drained it and it healed quickly. These abscesses will heal more quickly and with greater ease than the usual abscess of the breast heals.

Another thing I have noticed among babies is that they have mastitis. For many years I have seen a great many babies whose breasts were engorged but never went on to abscess formation. I have had four babies with impetigo in whom the breasts became engorged, and formed abscesses which had to be incised and drained. I do not think you can attribute them exactly to the influenza epidemic or to lowered resistance.

With regard to the treatment, one must be careful in opening these small abscesses not to do too much. They should be incised and drained, without any manipulation of the abscess cavity. The introduction of the finger or forceps to find whether lobules or abscess cavities are present may cause damage beneath the subcutaneous tissue which is not affected.

Dr. Eugene Cary: I wish to take exception to two statements made by Dr. Baer. First, with regard to the question of engorged breasts. I think the engorgement of the breasts is more or less mechanical. In other words, there is a beginning process in the breast that has lain dormant for a varying length of time, so that on the third or fourth day following delivery, as a rule, there is a great rush of blood to that part. My belief is that the veins in that breast have drained the normal, natural supply of blood to the breast, and on the third or fourth day, through some cause, as yet obscure, there is a sudden, increased blood supply to the breast, and these veins are called upon to do twice the work, the result being an acute congestion. This acute congestion means that there is more fluid going in than coming out. For that reason, there is a collection of fluid which means a swelling of the tissues, and there is an added restriction of the outflow, and my belief is that if that outflow is further restricted by putting on a tight binder or applying something which will congest the tissues, the trouble will be magnified.

It has been my practice for the last 7 or 8 years to try to relieve the resistance of the tissues by increasing tissue relaxation and dilating the veins rather than constricting them. For that reason, I have a standing order with all my cases that when the breasts become engorged and painful, they are to be steamed, which usually relieves the condition. The only reason I use a breast binder is for its supportive action, having it snug at the bottom and drawn up over the shoulders so that it acts as a hammock rather than a pressure binder. If a pad is put on the outside of the breast, and brought up to the midline, this is further facilitated. If heat is applied the tissues are relaxed and circulation is aided.

Another thing we want to realize, is that no matter where it is applied heat causes relaxation. A breast, when first used, will be hard, tense and painful, and the mere application of heat in the form of hot fomentations for 20 minutes, such as bath towels rung out of water, will give a great deal of relief from the pain. This is a procedure of routine with me and it works out satisfactorily; usually one steaming establishes increased circulation in the veins. It is a matter of half an hour or an hour. If the baby nurses after this the result is accomplished.

If the steaming does not relieve the congestion after nursing the next time, I usually make it a practice to steam the breasts thoroughly after having supported them in the proper position, and then apply pressure by the hands in a rotary manner, trying to express the venous engorgement, and massaging toward the axilla. The breast can be softened in this way and if gentle manipulation is practiced no damage is done to the tissues. The breast will be markedly smaller after the completion of the massage, and at the same time there may be practically no milk expressed from the nipple. Therefore, it seems to me the condition is not a congestion, enlargement, or caking due to retention of milk, but is simply a venous stasis.

When I was an interne, Dr. Lynch, now of San Francisco, told me that when he was at the Johns Hopkins they had treated five thousand cases expectantly, where the mother had either lost a

baby or had it removed from the breast for some cause. They simply let the breasts alone. I felt that was logical treatment, and I have been doing that ever since. I do nothing to the breast except put some hammock arrangement on without any compression so that it is comfortable. We have usually waited until the third day, and then I usually restrict liquids and give a saline cathartic, doing nothing to the breast. The next day the breasts are practically flaccid. There is a congestion period of about 6 hours, after which the breasts become flaccid and give no more trouble. A breast pump is never used.

If there is engorgement of the breasts and it is desired to continue lactation, why do you give cathartics?

Dr. Carl Wagner: I would like to ask Dr. Baer how he drains abscesses of the breast. I wish to mention a method in regard to the surgical aspect of abscess of the breast which has given me great satisfaction in the last 2 years in dealing with sinuses, as well as with carbuncles and suppurating areas in sinuses. I omit the use of all watery solutions of antiseptics, not even washing out the wound with such solutions. I use alcohol only on the outside of the wound. The sinuses I wash only with boric acid solution in the proportion of six drams to four ounces, which may be dropped into the sinus or put on cotton covered with nonabsorbable cotton, once or twice a day. The wound takes on a beautiful state of granulation, no matter in what part of the body I use this treatment. I do not wash out wounds any more; I do not put in a rubber drain except for a day or two. I like to get the abscess cavity enlarged on the outside, but the skin portion I treat a little longer than a day or two to permit me to drop in the boric acid and glycerin solution.

Dr. N. Sproat Heaney: Ordinarily I believe that we are liable to attribute our avoidance of breast abscesses to the efficacy of our prophylaxis and the occasional breast abscesses which occur to a breach in technique. When streptococcus is the infecting organism in breast infections, it usually is introduced. This is the unusual type of infection however. The usual breast abscess is due to staphylococcus, which is a normal inhabitant of the surface of the nipples, the layers of the skin and the ducts of the breast, and it is the trauma of nursing or a deformed duct which stirs the staphylococcus into action. When trauma occurs the organisms produce an inflammatory reaction with a resulting periductal inflammation so that the duct itself becomes occluded and milk does not escape from the corresponding section of the breast. In stasis the organisms in the duct multiply and so an abscess or inflammatory reaction occurs. Whether an abscess results or not, I am not so sure that we can attribute to the aborting action of any therapeutic measure that we use.

Whether a baby should nurse a breast which is inflamed or not is a question which I think is open to discussion. I have heard of only one case where a baby was harmed by nursing an infected breast. Metastatic abscesses developed and the baby died. Where only a segment of the breast is affected, and that segment is drained and the breast is otherwise functionating, I have seen no harm from the baby nursing. The chances of the baby being infected under these conditions is small, as shown by the examination of milk pumped from both an infected and an uninfected breast and cultured. This has been done in several of our cases and only occasionally does the diseased side show many more organisms than does the unaffected side. Staphylococci I think are present in every mother's milk. They are harmless until trauma through bruising or cracks disturb the breast function, when they may attack the tissue itself.

Dr. Lester E. Frankenthal: If we review the literature of the world, we must come to the conclusion that the influenza bacillus *per se* is of an innocent kind; that likewise patients who have had influenza are very susceptible to secondary infections. These secondary infections are usually caused by the staphylococcus, streptococcus, and pneumococcus. We see streptococcus anginas producing appendicitis, producing ovarian abscesses. We see in the wonderful paper written by Madelung on typhoid epidemics multiple abscesses in the breasts of patients. He quotes one instance, published in the *British Medical Journal* of 1902, of an abscess occurring in the breast 7 months after the onset of typhoid.

I therefore see no reason why one should doubt the direct relationship between our recent influenza epidemic and the increase in breast abscesses during that time.

If we have another epidemic, we shall attempt to control the occurrence of breast abscesses at the Michael Reese Hospital Maternity by obtaining the phagocytic and opsonic index of patients who have had influenza or have been exposed to the disease, and then governed by the index, we shall give them the mixed treatment of vaccines.

The last epidemic of influenza taught us the great possibility of abscess formation in spite of all care we could use.

I heartily endorse everything Dr. Hillis has said, and if I remember correctly, when he was an interne in the Michael Reese Hospital, we used the ice treatment.

When a woman has a rise in temperature, preceded frequently by a rigor, or chill, a sore spot in the breast with or without a visible superficial lymphangitis, we at once put the breast at rest, first however massaging the circumference of the breast in order to reduce all passive congestion, and subsequently applying compression with bandages, which previous to being covered by ice bags, are moistened so that the cold will readily penetrate to the skin. We have in mind two cases of extensive frost bites of the skin where the ice bag was directly applied to the same. If this treatment is instituted

early enough, we feel safe in saying that in 97 per cent of all cases of lymphangitis of the breast abscess formation can be prevented.

We make it a rule in the Michael Reese Maternity to have the head-nurse see every breast every day. It is for her to determine whether treatment is necessary or not. In this way we lose no time in instituting treatment at once.

I would like very much to stimulate some of the members of the society in the event of our having another influenza epidemic this winter, to try the prophylactic vaccine treatment in patients who either have had the influenza or who have been with influenza patients before their confinement.

Dr. Baer (closing): In answer to the comments of Dr. Hillis concerning the use of the ice bag, we have contended with that problem in the Michael Reese Maternity with nurses who have been taught throughout the institution to apply the ice dry, and we have re-educated them to apply it wet, because that is the best way in which to get the chilling effect of the ice. It will not chill well when applied dry.

Dr. Goldstine referred to impetigo contagiosa as the etiological factor in the increased number of cases of breast abscess. To my way of thinking it is a less likely cause than that which I have advanced this evening. Impetigo contagiosa spreads rapidly when it does occur as an epidemic in the nursery. Several babies get it. They are isolated, and within a number of days or a week or two the epidemic is usually brought under control; whereas here are cases that have occurred over a number of months, and I prefer to adhere to the underlying cause which had been acting for two years, namely, influenzal infections.

I want to correct one impression Dr. Cary had concerning the treatment which we employ at the Michael Reese Clinic for congestion of the breast. I will read from my paper. . . . "We do not tightly bind the congested breast. We give the breast more room. We do not use tight compression except when we suppress breast function."

Answering Dr. Wagner, rubber tubing has been used in the past, but that has been discarded. After incision and gauze packing, changed daily until healthy granulations appear, we use a compression sponge with tight binder to hold the compression sponge in place. That seems to shorten the period of healing one-half.

Dr. Heaney said he continues to nurse a threatening breast. We believe that a threatening breast, like an inflammatory reaction anywhere else in the body, is best treated by physiological rest. Physiological rest for the breast does not include nursing. We prefer not to nurse a threatened breast, but to stop nursing. We believe that an attempt to rest one breast by not nursing and continue nursing in the other breast is an utter failure.

PERINEORRHAPHY FOR COMPLETE LACERATION

Dr. Thomas J. Watkins read a paper entitled "Perineorrhaphy for a Complete Laceration." (See p. 360.)

DISCUSSION

Dr. Albert Goldspohn: In closing the rectal part of a complete laceration of the perineum the device of turning down a flap on the back of which the suturing is done, is very valuable, because the sutures can thereby be kept out of the rectal mucosa, where they otherwise become infected. But I regret to be obliged to criticise the doctor's technique in placing the sutures which are intended to reunite the torn sphincter ani and to close the rectal portion of the laceration. He represents that a leading suture in this attempt seizes the end of the torn sphincter and then is supposed to engage the *levator ani* muscle also, by something of a purse-string action. This attempt indicates a mistaken conception of the anatomy. The sphincter and levator are too far apart to make such a plan possible or feasible. The sphincter ani is among the outermost, almost subcutaneous, structures, of the perineum, while the levator ani is the extremely innermost structure in it. Down upon the normal level of the anterior rectal wall where this union should be made these structures are normally about 5 centimeters apart; and they are separated, among other tissues, by an unyielding septum composed of two layers of fascia with the deep transversus perinei muscle between them. This threeply non-elastic structure is called the *triangular ligament* in English anatomies, the *trigone* in some others.

It is the one relatively unyielding structure that a finger in the introitus meets normally, in a lateral movement, in cases where no laceration has occurred. I think the doctor, like many other operators, mistakes this intermediate fascial structure for the elevator ani. To bring the torn anterior portions of the levator ani and its fasciæ into effective apposition for real union, would require elevating a flap or extending the denudation and the suturing farther inward than is indicated by the essayist.

Dr. Watkins (closing): I am still convinced that I have some knowledge of the levator ani muscle notwithstanding what Dr. Goldspohn has said. I have repeatedly exposed this muscle and made direct suture when trying out the perineorrhaphy advocated by Malcolm L. Harris some years ago. I welcome this opportunity to make some general comments upon perineorrhaphies. The subject has become difficult chiefly on account of the confusion which has been injected into the literature. Aside from the literature, lacerations of the perineum are a relatively simple problem, both as to the nature and repair of the lesion.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

THIS work[1] by Dr. Heuser represents the latest and most thorough-going effort by a Spanish author to assemble the facts and principles relating to the practice of medical radiology. The work is well printed; the paper is satisfactory for the reproduction of roentgenograms; and the binding is substantial.

The first portion of the book is devoted to the technique of roentgenography with profusely illustrated descriptions of positions. Some new positions are described by the author, among them a new position for fractures of the occiput and a position for transrectal roentgenography of the coccyx and sacro-iliac joint. The author's acquaintance with apparatus is apparently confined to that of German origin. Since writing the book, he has visited the United States and has had opportunity to acquaint himself with the various types of American instruments. Due space is given the Coolidge tube.

As a matter of protection for the operator, the author advises that he stand always at a distance of at least 5 meters from the tube during roentgenography, protected by at least 4 millimeters of lead; and for roentgenoscopy, leather apron, protective shield, lead gloves, etc., and a maximum limit of 4 milliamperes in the tube. He very properly characterizes the lead glass tube holder as an "illusory protection."

That the work is unusually well up to date is attested by the detailed descriptions of methods of injection of air into the peritoneum, ventricles of the brain, etc. The author recommends for peritoneal injection a mixture of laughing gas, oxygen, and ether in place of oxygen, hitherto employed. As would be expected, appropriate space is devoted to the consideration of echinococcus disease of the lung and liver.

The latter portion of the book is devoted to the application of the X-ray in military surgery, and includes a detailed description of a number of localization methods including one which the author has named after himself.

This book is by far the best textbook on general roentgenography published in Spanish, and those who read Spanish will profit by its perusal.

JAMES T. CASE.

[1] TRATADO PRÁCTICO DE RADIOLOGÍA. By Dr. Charles Heuser. Buenos Aires: La Semana mèdica, 1920.

A MEDICAL book achieves a place upon our bookshelves in one of three categories; because of its value as a reference book, as a textbook, or because it represents an exhaustive, interesting, and well written mastery of a particular subject. Each field holds a distinct reward. A reference book is rarely a successful textbook, and a book to be used in teaching students cannot be a complete work of reference.

The subject matter covered in the book[2] under review does not lend itself to treatment other than that accorded to a book of reference. As such it appeals to us. Its value to an undergraduate student of medicine, we believe, is nil compared to its worth to the clinical neurologist. However, to be of value as a reference work, a book must have of necessity a complete, easily used index. Therein lies its worthiness. The bulk of this volume defies detailed criticism. However, testing it as a reference book, reveals a number of points of interest.

The aim of the authors to attempt to correlate anatomical and physiological neurology with the clinical aspect of the subject is a worthy one and is to be highly commended. Perhaps a happier arrangement of the subject matter, avoiding repetitions, would have allowed of a more detailed description of other points which are more desirable. A complete consideration of the cranial nerves is a case in point. Again, Ingvar's monumental work on the cerebellum should certainly have a place in a work of this character, as should the most recent work on the cerebral association tracts. The writers do not give credit in their subject matter to various authors, but have compiled a list of collateral reading references. Without doubt, this idea is valuable but in many instances failure to give credit is very obvious.

No doubt all of these points of omission are compensated for by the admirable translation the authors have given us of Déjerine's description of the internal capsule. The value of a good description in English of this structure has long been felt and this volume supplies that want fully.

As a whole, this stout compilation of many years of clinical experience and teaching is worthy to occupy a place upon the shelves of the most exacting member of the profession. L. E. DAVIS.

[2] THE FORM AND FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM. By F. Tilney, M.D., Ph.D., and H. A. Riley, A.M., M.D. New York: Paul Hoeber, 1920.

AMERICAN COLLEGE OF SURGEONS

STATE CLINICAL MEETINGS

Meetings of state sections of the Clinical Congress of the American College of Surgeons were held during February for the state of Arkansas at Little Rock, February 18 and 19; for Oklahoma at Oklahoma City, February 21 and 22; for Iowa at Des Moines, February 28 and March 1. At each meeting there were clinical, scientific, and public sessions and a hospital conference on standardization. The programs follow.

ARKANSAS

FRIDAY, FEBRUARY 18

Clinics

At the Baptist and City Hospitals and St. Vincent's Infirmary, 9 a.m. to 12 m.

Hospital Conference, 2:30 p.m.

William V. Laws, M.D., Chairman, Arkansas State Section, Presiding.

The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—James I. Scarborough, M.D., Little Rock.

Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—A. B. Tipping, Superintendent, Touro Infirmary, New Orleans.

Discussion—Opened by Anderson Watkins, M.D., Little Rock.

Public Meeting, 8 p.m.

Hugh Hart, Chairman.

Address of Welcome—Thomas C. McRae, Governor of Arkansas.

The American College of Surgeons—Harold M. Stephens.

The Relationship of the Surgeon to the General Public—William R. Cubbins, M.D., Chicago.

How the Public Can Assist in Reducing the Mortality of Cancer—C. Jeff Miller, M.D., New Orleans.

The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.

SATURDAY, FEBRUARY 19

Clinics

At the Baptist and City Hospitals, and St. Vincent's Infirmary, 9 a.m. to 12 m.

Scientific Session, 2:30 p.m.

William V. Laws, M.D., Chairman.

Fracture of the Lower End of the Ulna—St. Cloud Cooper, M.D., Fort Smith.

War Orthopedics Applied to Civil Life—John S. Jenkins, M.D., Pine Bluff.

Frontal Sinus Operations—H. R. T. Mann, M.D., Texarkana.

The Treatment of Carcinoma of the Uterus by Surgery and Radium—C. Jeff Miller, M.D., New Orleans.

The Present Status of the Operative Treatment of Fractures—William R. Cubbins, M.D., Chicago.

OKLAHOMA

MONDAY, FEBRUARY 21

Clinics

At St. Anthony and Wesley Hospitals, 9 a.m. to 1 p m

Hospital Conference, 2:30 p.m.

Horace Reed, M.D., Oklahoma City, Chairman, Oklahoma State Section, Presiding.

The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—Horace Reed, M.D., Oklahoma City.

Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—P. H. Fesler, Superintendent, State University Hospital.

Discussion—Opened by LeRoy Long, M.D., Oklahoma City.

TUESDAY, FEBRUARY 22

Clinics

At the University and Baptist Hospitals, 9 a.m. to 1 p.m.

Scientific Session, 2:30 p.m.

Address of Welcome—LeRoy Long, M.D., Oklahoma City.

Proper Operation for Carcimona of the Breast—Jabez N. Jackson, M.D., Kansas City.

The Treatment of Carcinoma of the Uterus by Surgery and Radium—C. Jeff Miller, M.D., New Orleans.
Paper—Fred S. Clinton, M.D., Tulsa.
Discussion of cases presented at the morning clinics—McLain Rogers, M.D., Clinton, Okla.; F. L. Carson, M.D., Shawnee, Okla.; S. L. Murdock, M.D., Sabetha, Kans.; R. V. Smith, M.D., Tulsa, Okla; A. W. Roth, M.D., Tulsa, Okla.; and D. D. Esterley, M.D., Topeka, Kans.

Public Meeting, 7:30 p.m.

Horace Reed, M.D., Chairman, Oklahoma State Section, Presiding.
Address of Welcome—Dr. Stratton D. Brooks, President, Oklahoma State University.
The American College of Surgeons—Harold M. Stephens.
The Menace of Cancer—Jabez N. Jackson, M.D., Kansas City.
How the Public Can Assist in Reducing the Mortality of Cancer—C. Jeff Miller, M.D., New Orleans.
Standardization of Hospitals—Rev. C. B. Moulinier, S.J., Milwaukee.
Why the Church Believes in Medical Education of the Laity—Rev. I. Frank Roach and Rev. E. D. Salkeld, Oklahoma City.

IOWA

MONDAY, FEBRUARY 28

Clinics

At the Iowa Methodist and Iowa Lutheran Hospitals, 9 a.m. to 12 m.

Hospital Conference, 2:30 p.m.

The Hospital Program of the American College of Surgeons—Harold M. Stephens, Director, Hospital Activities, American College of Surgeons.
The Soul of Standardization—Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—Rev. F. O. Hanson, Superintendent, Iowa Lutheran Hospital.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—Donald Macrae, M.D., President, Iowa State Medical Society.

Public Meeting 8 p.m.

W. W. Pearson, M.D., Chairman.
Address of Welcome—N. E. Kendall, Governor of Iowa.
The American College of Surgeons—Harold M. Stephens.
The Menace of Cancer—J. N. Jackson, M.D., Kansas City.
Public Health and Community Responsibility—John B. Deaver, M.D., Philadelphia.
The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.

TUESDAY, MARCH 1

Clinics

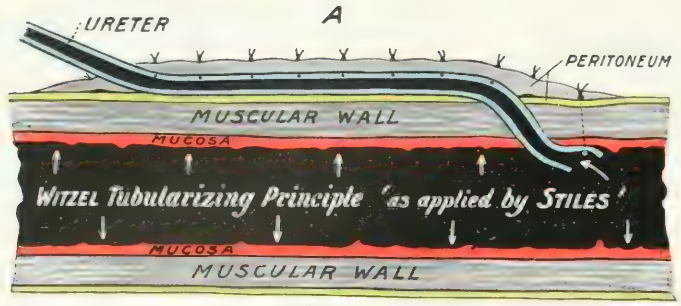
At the Iowa Methodist and the Iowa Lutheran Hospitals, 9 a.m. to 12 m.

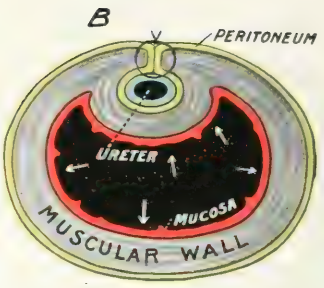
Scientific Session, 2:30 p.m.

W. W. Pearson, M.D., Chairman.
Jaundice—John B. Deaver, M.D., Philadelphia.
Proper Operation for Cancer of the Breast—J. N. Jackson, M.D., Kansas City.
Factors of Safety in Surgery—Major G. Seelig, M.D., St. Louis.

Meetings to be Held

Ohio—Cleveland, April 1 and 2.
New Jersey—Newark, April 11 and 12.
Virginia—Richmond, April 14 and 15.
West Virginia—Wheeling, April 18 and 19.
Michigan—Detroit, April 28 and 29.





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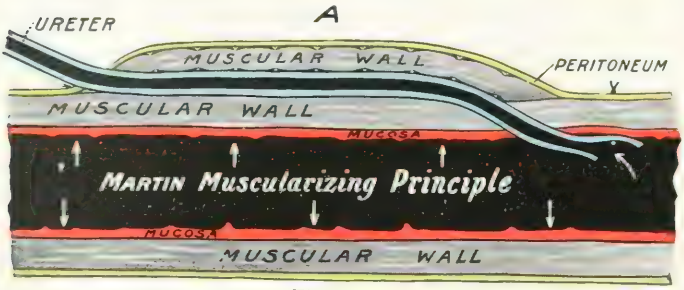

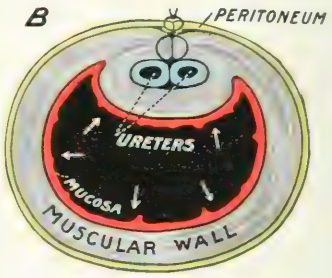

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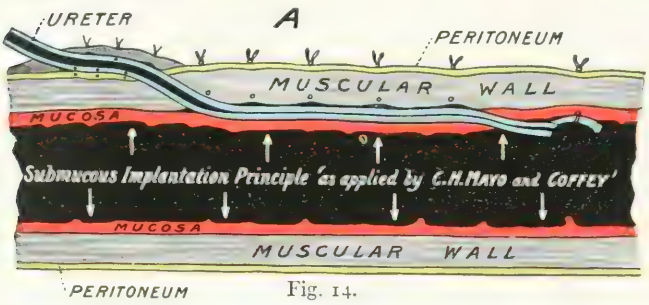

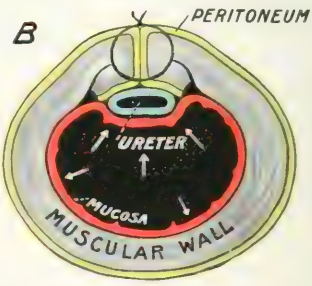

Fig. 14.

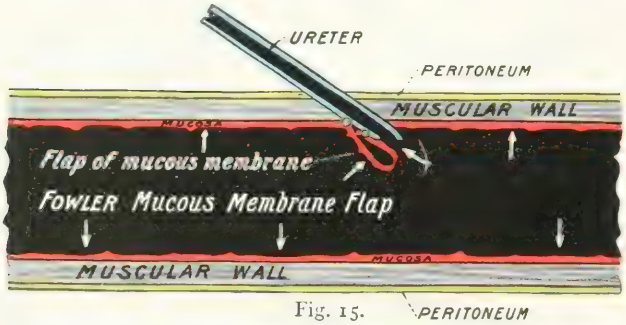

Fig. 15.

Fig. 12. The Witzel tabularizing principle, as applied by Stiles. *A*, Note that the entire thickness of the intestinal wall, including muscle, mucosa, and peritoneum, is interposed between the ureter and lumen, making collapse of the ureter impossible. *B*, Cross section showing relation of the ureter to the wall, in the Stiles operation.

Fig. 13. The Martin muscularizing principle. *A*, The peritoneum has been dissected off the muscle and the muscle wall is made to form a virtual sphincter around the ureter. The peritoneum is then closed over all. It is evident that intra-intestinal pressure could not effectually close the mucosa if the muscular wall were completely intact. *B*, Cross section which shows the principle and how the muscle is drawn around the ureter.

Fig. 14. Submucous implantation principle. *A*, The ureter is seen to traverse the space between the mucous membrane and the muscle, the mucous membrane having been carefully freed from the muscle. *B*, Cross section shows the principle involved and how the thin, loose mucous membrane alone intervenes between the intra-intestinal pressure and the ureter.

Fig. 15. The principle of the Fowler mucous membrane flap, which is in no way similar to the three previously described principles.

Transplantation of Ureters into Large Intestine in the Absence of a Functionating Urinary Bladder.—Robert C. Coffey.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

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TRANSPLANTATION OF THE URETERS INTO THE LARGE INTESTINE IN THE ABSENCE OF A FUNCTIONATING URINARY BLADDER[1]

BY ROBERT C. COFFEY, M.D., F.A.C.S., PORTLAND, OREGON

ELIAS HOWE invented the sewing machine and patented it. In a few years there were great numbers of sewing machines of other makes and under other names, equal to or better than the Howe machine. It has been said that there was but one mechanical principle that he was able to hold under his patent. That was: "An eye at or near the point of the needle." Without using this fundamental mechanical principle the sewing machine could not be made. Fundamental principles of this kind have been used by nature in the human organism when possible, but they have usually been supplemented, in vital positions, by a certain development of muscular fibers. For instance, a defect in the valves of the heart is compensated for by increased muscular development of the heart. A defect in the valves of the superficial veins of the leg produces varicose veins but is compensated for by muscular action which carries the blood along the deep veins toward the heart.

I have been credited in some textbooks and other publications with the technique of an operation for implantation of the ureter into the large intestine, which is gaining in popularity. I am very proud of this recognition, yet I have not been entirely satisfied with it as I contend the technique was developed only after the essential principles had been formulated. I will briefly relate the development of this operation.

In the home of Dr. W. J. Mayo, in the winter of 1908, I was listening to his analysis of surgical problems and surgeons. Finally, the question turned to my own work, which he discussed encouragingly in some instances and disparagingly in others. During this discussion he suggested that the pancreas was a very prolific field for investigation and urged me to see what could be done with it.

I accepted the suggestion, went home, constructed a new animal hospital, and started to work. I immediately recognized that the one essential thing necessary to do surgical operations on the pancreas was the ability to deal with the remaining pancreas after a portion had been removed. Removal of the head of the pancreas was a difficult problem. This, however, we did successfully by doing it in two operations. First, the stomach was cut off, a gastro-enterostomy performed, the bile-duct transplanted into the duodenum lower down by the direct method described by W. J. Mayo a few years before (Fig. 1). Two weeks or more afterward, the duodenum and head of the pancreas were removed. Then the pancreas was implanted into a specially prepared loop of small intestine (Fig. 2).

In the conduct of the experiments a more interesting problem than the original one presented itself. I noticed that in every instance where the common bile-duct had been implanted into the duodenum it had become very much dilated (Fig. 3). In one instance

[1] Read before the Clinical Congress of American College of Surgeons, October, 1920.

Fig. 1. First step in two-stage operation for removing the head of the pancreas, as was done in the first series of experiments. *a*. Bile-duct transplanted to intestine below the pancreas by direct implantation. *b*. Posterior gastrojejunostomy. *c*. Stomach cut in two and ends turned in. Dotted line encloses part to be removed at next operation. (*Annals of Surgery*, December, 1909.)

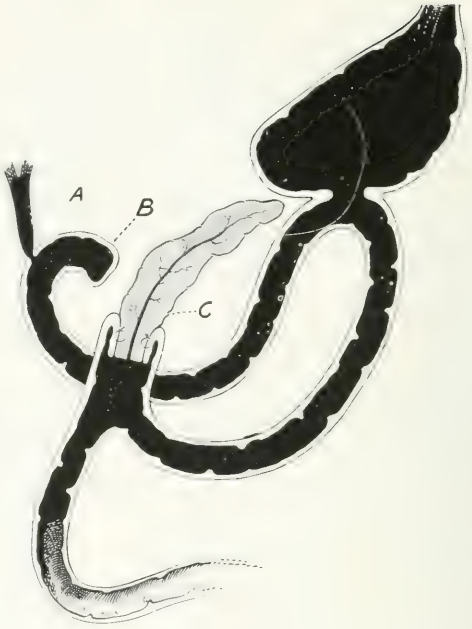

Fig. 2. Second step in two-stage operation for removing head of the pancreas. *a*. Widely distended bile-duct which was transplanted at previous operation. *b*. Remaining stump of duodenum after removal of duodenum and head of the pancreas. *c*. Remaining tail of the pancreas implanted into intestinal loop. (Diagrammatic.) (*Annals of Surgery*, December, 1909.)

it was found to be even as large as the duodenum. This dilatation had apparently continued until a compensatory thickening of the duct wall had stopped the process. This dilatation, including the opening into the intestine, therefore, was not due to obstruction. The following soliloquy or catechism took place in my mind. Why does the common duct, thus implanted, dilate and thicken in this way? Evidently because of some force exerted within the duct. What force is there present? Answer: The small intestine, as well as the large, is practically always found in a state of rotundity and partial distention. That distention is chiefly gas or liquid under pressure. That pressure may, for want of a better name, be called *intra-intestinal pressure*. In short, my conclusion was that the thin-walled duct implanted into the intestine directly was dilated by *static intra-intestinal pressure*. That was the chief proposition. The second proposition was, how has nature prevented this *intra-intestinal pressure* from reaching the inside of the normal duct?

Dissection of the duodenum showed that the common duct passed through the wall of the intestine down to the mucosa and ran for a distance under the loose mucosa before emptying into the bowel. This probably accounted for the normal undilated state of the common duct. The next question: "Is it purely a mechanical affair or due to muscular control?" A rubber bag, an ordinary irrigation bag, was taken. A hole was made in it and a rubber tube cemented into the hole. A thin flap of rubber was cemented on the inside of the rubber bag. A fountain syringe was attached to the rubber tube and the rubber bag was filled from the fountain syringe through the rubber tube. On detaching the fountain syringe from the filled rubber bag no water escaped. Pressure within the rubber bag collapsed the valve completely (Fig. 3). Therefore, whatever influence the muscle in the duodenum might have had, it was possible to protect the duct by purely mechanical principles.

Up to this point no technique has been tried and yet I contend that all the principles for

the successful implantation of a duct have been assembled. Namely, we have found that a duct always dilates when implanted directly into the intestine; that it thickens and establishes a point of compensation; that this dilatation is due to force; that this force is the gas and liquids confined in the intestine, and may be called *intra-intestinal pressure*. Nature has run a duct immediately under the loose mucosa permitting of closure by *intra-intestinal pressure*. And finally, an inanimate, mechanical appliance proves that the mechanical feature is sufficient of itself to prevent dilatation of the duct. All the engineering and all the architectural work has now been done. We are ready for the mechanical work. We, therefore, tell the mechanic that he is to implant this duct or tube into the intestine and that he must run the tube for some distance immediately under the mucous membrane before it emerges into the lumen of the bowel. In other words, the mechanic works out the technique. I have been credited with the mechanical part of the work but not with the architectural or engineering. As a matter of fact, the technique of placing the ureter immediately under the mucous membrane, as described, did not require much thought and is not a procedure that should add much to the reputation of any surgeon. I am sure any surgeon of average ability would have done the same after the principles had been assembled and formulated.

Having formulated these principles the next step was to implant the duct. As a matter of proof we implanted the common duct in a series of dogs by running the ducts immediately under the mucosa by the technique herein described. In not a single instance did the common bile-duct dilate when so implanted. Up to this time the question of implantation of the ureter had not been thought of by me. I had never read an article on the implantation of the ureter nor did I know anything of the methods that had been tried.

In going through the literature of the common bile-duct, during the preparation of the paper, I began to discover references to the literature of implantation of the ureter into the intestine, so that when the paper on the pancreas, including the implanting of the bile-duct was presented, at Hot Springs, Virginia, in 1909, I made the suggestion that the same principles would probably apply to the implantation of the ureter. And when I came home, started another series of experiments to test out the feasibility of the application of these principles to ureteral implantation.

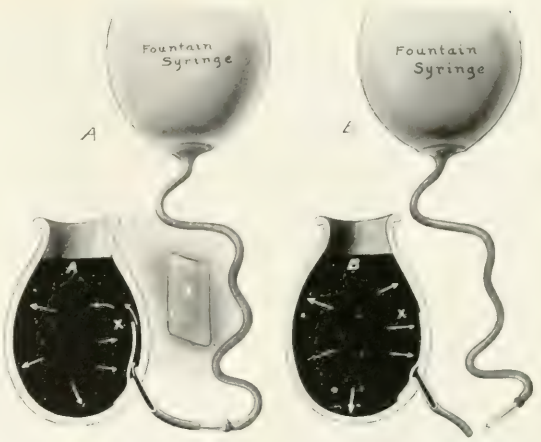

Fig. 3. Partial artificial lining of a rubber bag with a thin piece of rubber cemented on the inside. *a*. The fluid is running into the bag notwithstanding the pressure indicated by the arrow because the height of the fountain syringe produces greater pressure than exists in the bag. *b*. When the greater pressure from the fountain syringe is removed, the intravesical pressure collapses the inside lining.

In six dogs the same method of direct implantation of the ureter was applied as was used in the direct implantation of the bile-duct. All of the dogs died except one. In the one which lived the ureter was somewhat dilated and very much thickened, and the kidney had been destroyed, leaving a fibrous knot. The opening into the bowel was large and the ureter was a diverticulum on the large intestine, ending with the pelvis of the fibrous knot which represented the destroyed kidney (Fig. 4, *b*). Of nine dogs in which the ureter was implanted by the submucous method, six recovered, from five of which specimens were taken to the meeting of the American Medical Association, at St. Louis, in 1910, and presented to the surgical section, of which Charles H. Mayo was chairman at that time. Those who were present may remember that in none of those specimens was the ureter dilated or the kidney injured.

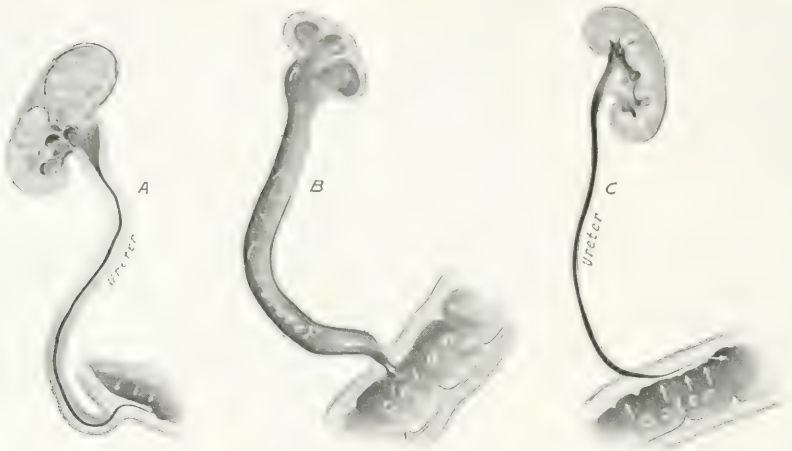

Fig. 4. The *modus operandi* of so-called "ascending infection." *a*. What probably happens in experiments where infection is injected around the ureter near the bladder; a true ascending infection following the lymphatics. *b*. Dead kidney; dilated ureter following direct implantation of the ureter into the colon. This result has been usually referred to as "ascending infection." It is more probable that the kidney has been destroyed and the ureter dilated by static intra-intestinal pressure applied inside the ureter. *c*. Normal kidney and undilated ureter which follow the submucous or indirect implantation of the ureter into the colon. (See Figs. 5, *a* and *b*.)

In fact, the closure of the duct against internal pressure by applying the static intra-intestinal pressure to the side of the duct was a success proved by the specimens (Figs. 4; 5, *a* and *b*; and Fig. 6).

In the preparation of this paper, before proceeding, I employed Dr. C. A. Fender, bibliographer in the Surgeon General's library, to go over the literature on ureteral implantation and abstract all articles pertaining to the phase of the subject I had under consideration. His abstracts failed to reveal any article which had set forth an operation based on the fundamental principles above given. Connell, Peterson, and Steinke had all reviewed the literature and had all reached the conclusion that ureteral implantation, experimentally on dogs at least, had a common ending, namely, destruction of the kidney, sooner or later. Therefore, this was the first series of consecutive successful implantations of the ureter into the large intestine of dogs that had been reported.

I came up to the St. Louis meeting with the following evidence that our principles above set forth, were true:

1. The bile-duct when implanted directly into a dog's small intestine always dilates.

2. A bile-duct which has been transplanted and made to run immediately under the mucosa of a dog's intestine for a distance does not dilate.

3. A ureter implanted directly into a dog's intestine always dilates and sooner or later the kidney is destroyed by pressure and infection.

4. A ureter which has been transplanted and made to run immediately under the mucosa of the intestine of a dog does not dilate, as a rule.

From this point the subject was largely developed by Charles H. Mayo into a clinical procedure which I believe must eventually be universally recognized.

The original technique which was first used on the common duct and later on the ureter by me is as follows:

First, the duct is located and ligated with linen or silk. It is then cut in two above the ligature and the edges caught and held with mosquito forceps, while one wall of the duct is split down with a pair of scissors. A linen suture is passed through the split end of the duct so as to include about one-half of it, and tied. The linen thread is thrown around the other half and tied. The loose ends are

threaded into two needles (Fig. 7). By this method the full strength of the duct is retained for traction, while the opening is maintained by the split. The end of the duct is wrapped with gauze while the intestine is prepared for its reception, which is done as follows:

The part of the intestine desired is picked up and an incision made down through the peritoneal and muscular coats, including submucous tissue. The muscular layer is loosened from the mucosa with the point of the knife until the mucous membrane pouts out through the incision. This incision should be about one inch long or more (Fig. 8). Then, five or six sutures are passed which pick up the peritoneal and muscular coats on each side of the incision. The suture at the upper end of the incision is tied as a control suture. The intermediate intestinal sutures are lifted up on the flat handle of an instrument as they cross the incision. Now the intestine is brought down close to the end of the split duct and the two needles carrying the threads (traction sutures) on the end of the duct are passed beneath the four or five intestinal sutures and through the stab wound in the mucous membrane into the intestinal lumen and out through the intestinal wall three-quarters of an inch farther along the intestine, and one-eighth to one-quarter inch apart. By making the tension on these threads and at the same time pushing the intestine toward the duct, the duct is drawn beneath the intestinal sutures through the stab wound into the intestinal lumen (Fig. 9). The two ends of the threads on the duct are tied on the outside, thus anchoring the ends of the duct on the inside of the intestine at this point. The intestinal sutures are then tied. After this operation the duct lies just beneath the mucous membrane, which has been loosened for approximately three-quarters of an inch of its course, so that it slides easily in its new channel. It is therefore necessary to tack the ureter to the peritoneum of the intestine near its point of entrance by two or three fine linen or silk blood-vessel sutures (Fig. 10). Care should be used to take only the outer coat of the ureter in the bite of these sutures. Thus, practically all of the steps of the operation are completed before the intestinal mucosa is penetrated and no sutures penetrate the lumen of the ureter. The traction suture at the end of the ureter within the intestine and the two or three anchor sutures fastening the duct to the intestinal peritoneum are the only means of retaining the duct in place. (For additional security another line of continuous chromic catgut suture may be made to cover in this first line as recommended by Charles H. Mayo.)

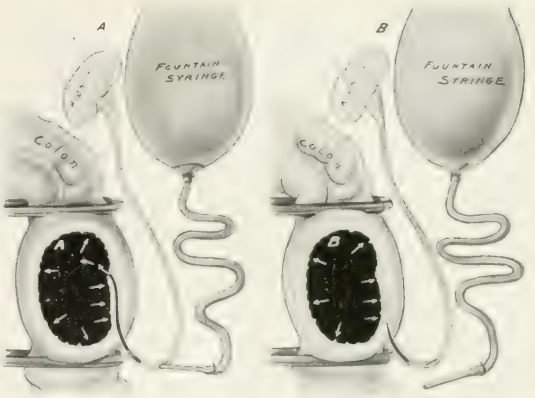

Fig. 5. Segment of intestine into which the ureter was implanted 169 days prior to removal of specimen. *a*. Running fluid into segment of intestine under pressure. (A counterpart of experiment made on rubber bag, Fig. 3.) *b*. Shows pressure of fountain syringe released by withdrawal of nozzle. The pressure within the intestine immediately closes the valve by pressure on the mucous membrane. Not a drop could be forced back into the duct. (An exact drawing of the valve in the same specimen is shown in Figure 6, *b*, compared with the valve in a normal dog's bladder, Fig. 6, *a*.)

The modifications in technique and clinical application which have been done by Dr. Mayo may be grouped and expressed in the one word, "clinicalization," and are as follows:

He has used fine catgut instead of linen. He has left off the control suture at the upper end of the implantation wound. He has used curved rubber covered clamps for holding the intestine. He has supplemented the interrupted sutures with a continuous catgut (Fig. 11). He has called attention to the necessity of implanting the right ureter first low down in the rectum, and at the same time fastening the parietal peritoneum to the intestine near the anastomosis. Ten days or two weeks later he transplants the left ureter

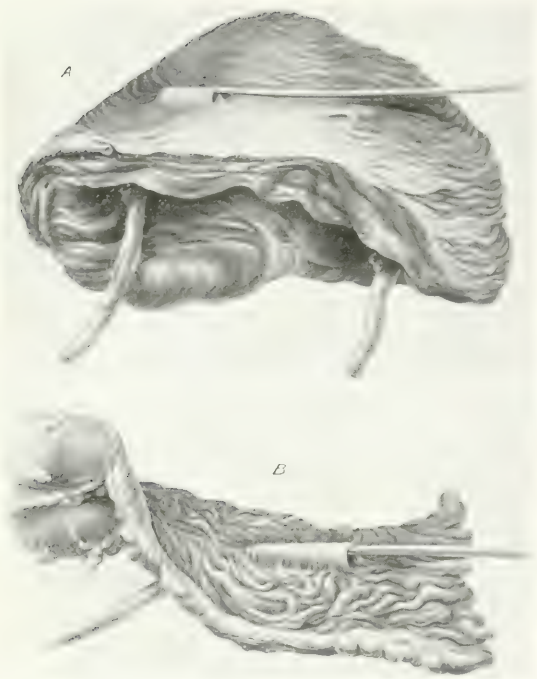

Fig. 6. *a*. The valve in a normal dog's bladder is lifted on the end of a probe. *b*. The valve in a dog's intestine following submucous implantation. Specimen removed 169 days after implantation. Compare with valve in dog's bladder.

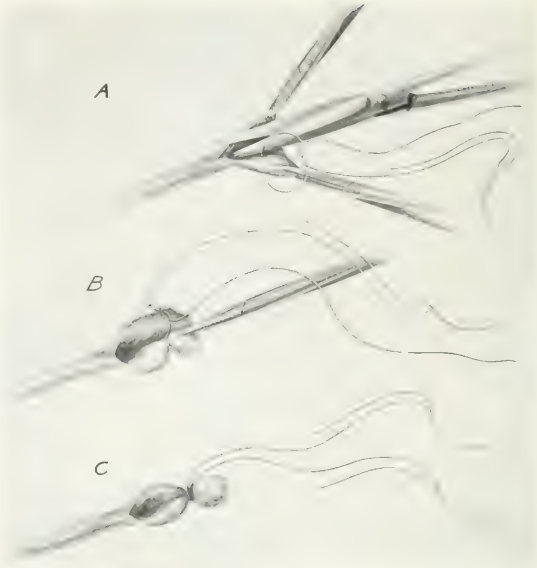

Fig. 7. Preparing the duct for implantation. *a*. Duct has been cut; the end is being split; a linen or silk thread is passed through half of the duct and tied. *b*. The other half of the duct is being tied. *c*. Both ends of sutures threaded into needles.

to the sigmoid and states that Dr. Judd has further modified the technique on the left side by reaching the ureter outside the peritoneum and doing the anastomosis between the ureter and sigmoid extraperitoneally.

In the after-treatment Dr. Mayo recommends the use of a perforated rubber tube in the rectum for some days afterward, particularly after the second operation. He states that the most favorable age for operation is from 4 to 10 years. In Osler's *Memorial Volumes* Dr. Mayo makes the following report of his work on exstrophy of the bladder:

"In our series of 52 patients, 6 were operated on by the plastic method; 1 died 6 months later (traumatic exstrophy at childbirth); 3 patients were operated on by the Maydl-Moynihan method, 2 of whom died of uræmia. Twenty-six were operated on by the transplantation method, 22 successfully; 2 of these patients had but one kidney each. Four died shortly after operation. Seventeen of the 52 patients were not operated on at the time of their examination; some of them were too young and are to be operated on later; others with diseased or dilated ureters were advised against the operation."

In addition to this large clinical experience of Dr. Mayo I may briefly report my own clinical experience as follows:

Case 1. My first patient was operated on October 17, 1913, for extensive, and I may say, almost inoperable cancer of the uterus, in which the base of the bladder and about 4 inches of the left ureter were involved in the mass. The uterus and left ureter, and a portion of the bladder were removed and the bladder wound closed. The carcinoma also involved the sigmoid flexure by contact, and the sigmoid flexure was therefore removed. The proximal end of the sigmoid was brought out through the left rectus muscle, making a permanent colostomy. The distal end of the sigmoid and rectum were closed and the left ureter implanted into the isolated rectum. The left kidney began to secrete urine immediately in a somewhat larger quantity than the right ureter was delivering into the bladder. The patient lived for about 8 months, finally dying of recurrence of the cancer in the liver and upper abdomen. I was informed by the family that the rectum continued to discharge clear urine up to the time of the patient's death, so that while the patient died 8

Fig. 8. Incising peritoneal and muscular coats of intestine and freeing mucous membrane from the muscular coat.

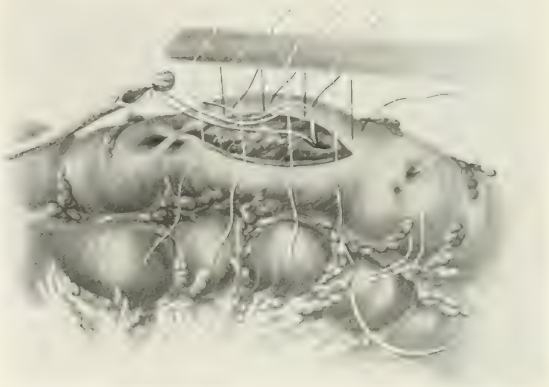

Fig. 9. Sutures have been passed and duct is being drawn down under the intestinal sutures through the stab wound in the mucous membrane.

months later, the result of the implantation was perfect.

Case 2. On January 3, 1914, I implanted a ureter for exstrophy of the bladder in a male child, 2 years of age. There was a good deal of fever on reaction and the child was quite sick for 2 or 3 days, which phenomenon, by the way, Dr. Mayo had told me privately, has occurred in most of his cases, the exact cause of which we do not know. On June 17, 1914, I implanted the other ureter. This has been now 6 years since the operation. I am informed that the patient is in perfect health; is able to go to school as other normal children; the bladder has never been removed as the father is well satisfied with the condition as it is at present.

Case 3. This was one of far advanced cancer of the bladder in a man. Most of the bladder wall was involved. The patient was very uræmic. On November 11, 1912, I implanted the right ureter into the pelvic colon. It was quite dilated and was probably thicker than it should have been for this purpose. The implantation was a success and the ureter immediately began to discharge its urine into the rectum. December 8, 1915, the left side was opened with a view of implanting the left ureter, also, when it was found that the ureter was dilated, thickened, and after it was cut it was shown there was no urine being excreted. In other words the kidney was dead from back pressure. It never came to life again. At this time the bladder was removed; the patient went home and died several months later from recurrence of the carcinoma in the abdomen. In this case the lone right kidney apparently was never involved.

Case 4. This was a young female child, 6 years of age, who came to me December 7, 1917, with exstrophy of the bladder. The right ureter was implanted at this time. February 28, 1918, the child returned and the second ureter was implanted. There was a great deal of disturbance at this second operation. The patient made a good recovery and I am informed has been perfectly well ever since. The bladder in this case has not been removed, as the mother is so well satisfied with the child's condition she dislikes to have anything further done.

Case 5. January 28, 1918, a man came for contraction of the bladder, which had been ulcerated for many years, and which held less than an ounce of water under anæsthesia. The patient suffered tremendously and was decidedly uræmic. February 2, 1918, the abdomen was opened with a view of implanting the left ureter, and was found to be dilated to a size larger than a man's middle finger. It was, therefore, brought out through the left rectus muscle, hoping that the other ureter would be in better condition and that we might be able to implant the other and use the left kidney to functionate in the meantime. February 19, 1918, we opened the right side and found this ureter dilated larger than a man's little finger; very thick, unfitted, according to Dr. Mayo's experience as well as my own, for implantation into the bowel. The rectum was held over to the left side by adhesions to such an extent that we could not mobilize it and use it, thus proving the soundness of Dr. Mayo's contention that the right ureter must be implanted first. Therefore, the ureter was implanted into the cæcum. The patient was quite sick for a number of days; was decidedly uræmic; recovered entirely; went home; had loose bowel movements for several months. July 19, 1918, he came back with a view of having the left ureter implanted into the descending colon, as he was perfectly well and desired to get rid of the discharge of urine through the fistula. He stated at this time, however, that he had had loose bowel movements up to about 2 weeks before. This had gradually subsided. We then flushed out the bowel for a day or two and put a tube into the rectum to see whether the kidney had ceased to functionate. No urine apparently came down

Fig. 10. The duct has been implanted and anchored at its end inside the intestine by a traction suture; part of the intestinal sutures have been tied; the small anchor sutures are fastening the ureter to the peritoneum of the intestine; two of the intestinal sutures remain to be tied over the small anchor suture; the traction suture is being covered in by a Lembert purse-string suture.

through the rectum. Therefore, we concluded that the kidney might possibly be dead although the man was in perfect health. We decided to let well enough alone and left the other ureter discharging through the left rectus muscle high up, inasmuch as the patient was otherwise in perfect health and was required to wear only one cup to catch the urine.

I may state, the bladder has never given him a particle of distress since the urine was diverted.

Thus we have had four cases in which six ureters were implanted, and in which function afterward seemed to be perfect. We have had a fifth patient with implantation of the seventh ureter into the cæcum, in which the function of the kidney is not known. It may be secreting normally and the urine is reabsorbed, or it may be that the kidney has been killed by intra-intestinal pressure. At any rate, the man is in perfect health and never has had a symptom in the neighborhood of the right kidney.

At medical meetings and in reading the literature I have often been amused and at the same time somewhat exasperated at the careless way in which surgeons have apparently studied this subject. For instance, it is nothing uncommon for someone to stand in a meeting and state that this application of these principles is nothing new, that it has been done for 25 years or more. Others will describe it as a modification of the Martin

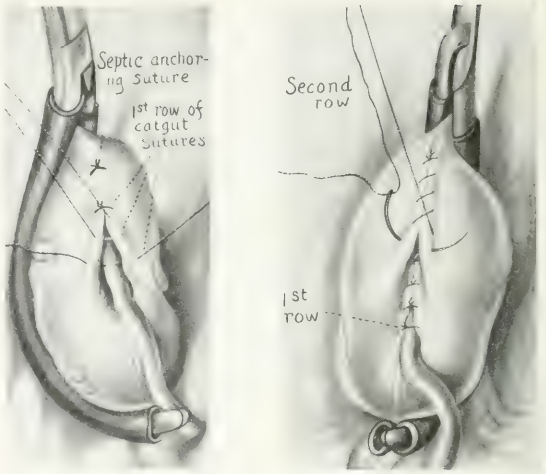

Fig. 11. C. H. Mayo's modification of the original submucous implantation described in Figures 7 to 10. Mayo has modified the technique as follows: (1) Use of curved rubber-covered clamps to hold the intestine. (2) The control suture at the upper end of incision shown in Figure 9 is omitted. (3) Fine chromic catgut is used instead of fine blood-vessel linen or silk. (4) Every other interrupted catgut suture picks up the ureteral wall. (5) A continuous catgut suture covers in all interrupted sutures. Osler *Memorial Volumes*, vol. ii.

operation, another of the Stiles operation, and another of the Fowler operation.

A careful study of these operations as described by the originators themselves, shows very clearly that the principles which we have set forth have in no way entered into the actions of these operators.

The Stiles operation is merely the rolling in of the entire thickness of the intestinal wall around the ureter. No mention is made of *static intra-intestinal pressure* as the means by which the outlet of the ureter is controlled. Furthermore, it is self-evident that even if the writer has had such an object in view, it would have been defeated by the thickness of the bowel.

The Fowler operation depends upon a loose flap of mucous membrane, which, according to the author himself, was intended to be pushed down by the fæcal mass in its descent, and made to cover the end of the ureter and in no way involved in the *static intra-intestinal pressure* produced by constant pressure of gas, which of course, would be as strong below the valve as above it.

The Martin operation is harder to differentiate from the submucous operation in that he cuts through the peritoneum down to the muscle and brings the muscle around the ureter, to be used as a sphincter to control the lower end of the ureter. However, he also combines, in his statement of principles, the Fowler principle which had been described the year before, and states that the fæcal mass, in passing down, would by its pressure on the mucous membrane, squeeze shut the end of the ureter and thus prevent fæcal matter from ascending it. In no place does he mention the influence of *static intra-intestinal pressure*, which is constantly present except in the wake of a peristaltic wave. Furthermore, the very fact of the muscle being between the ureter and the mucous membrane would, theoretically at least, prevent the collapse of the ureter by *static intra-intestinal pressure*. Furthermore, while about 45 per cent of reported direct ureteral implantations in the human have survived the operation and some of them have lived for a number of years, there is no absolute clinical evidence that the Martin operation, the Fowler operation, or the Stiles operation would give materially better results than the other direct implantations. We, in contra-distinction, submit Dr. Mayo's record along with my own and also that of Dr. Lower, of Cleveland, Dr. Hunner of Baltimore, and others, and contend that our results for submucous implantation of the ureter are sufficient to make it a justifiable operation and one which, after the technique has been tried out and perfected by experience of years, will probably make the question of bladder surgery much more settled and much more successful.

SUMMARY

Transplantation of the ureter into the large intestine is the most essential procedure in operations requiring removal of the urinary bladder.

The principal force to be dealt with in implantation of a duct into the intestine is *static intra-intestinal pressure*. The influence of *static intra-intestinal pressure* in dilating an unprotected duct mouth was first mentioned and described before the Southern Surgical Association meeting, at Hot Springs, Virginia, in 1909, and before the American Medical Association meeting, at St. Louis, in 1910. Submucous implantation of the duct, for the purpose of reversing the force of *static intra-intestinal pressure* and bringing it to bear on the side of the duct, was demonstrated in the same presentation, including the technique of the operation.

The essential mechanical principle necessary to the uniformly successful implantation of the ureter is that *the ureter shall be made to run immediately under the loose mucous membrane for a distance, before entering the lumen of the intestine.*

HIGH TRACHEOTOMY AND OTHER ERRORS THE CHIEF CAUSES OF CHRONIC LARYNGEAL STENOSIS

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IS high tracheotomy a justifiable operation? Before giving an opinion as to what the answer should be, it would be well to present gleanings from over 30 years' experience in the treatment of chronic laryngeal stenosis. During all these years the author has never been without cases of this kind to which he has fallen heir because the tracheotomists could not decannulate their patients, owing to an insufficient airway remaining in the larynx after the acute laryngeal stenosis had subsided; in other words, an acute laryngeal stenosis requiring tracheotomy had been followed, after tracheotomy, by a chronic laryngeal stenosis which prevented removal of the cannula after the acute condition, such as laryngeal œdema from diphtheria or some other inflammatory condition, had subsided. In a small proportion, approximately one-sixth of the cases, there had been necrosis of the cartilaginous framework of the larynx, probably due to the primary condition for which the tracheotomy was done. In the rest of the cases, approximately five-sixths, the chronic stenosis had been due to faulty tracheotomy or to improper after-care. This is in marked contrast to the results in our own cases. In a series of over one hundred cases of acute laryngeal œdema, tracheotomized by someone of us, not one case of chronic laryngeal stenosis resulted. The inference is plain that some radical difference in method exists, and investigation of the textbooks shows that tracheotomy is wrongly taught. The author believes that the patients coming to the bronchoscopic clinic for the relief of chronic laryngeal stenosis demonstrate that tracheotomy is the worst done of all operations and is perhaps the only one that has not been raised to its proper modern plane. This does not mean that all cases of chronic laryngeal stenosis are due to the tracheotomy; but the material shows plainly that high tracheotomy should never be done, and that the proper technique of after-care is generally unknown.

The tracheotomic causes of laryngeal stenosis may be classified under eight heads:

1. Hasty operation;
2. Attempts at general anæsthesia;
3. High tracheotomy even when classically done;
4. Division of the cricoid cartilage;
5. Sewing up of the wound;
6. Improper postoperative care;
7. Wearing of a cannula of improper size, shape, or material, or one with a fenestra;
8. Neglect of ordinary, decent cleanliness in the wearing of the cannula.

Going deeper, the chief underlying cause is in the faulty teaching of the textbooks. It is time that all sections on tracheotomy were rewritten. In passing it may be stated that all the foregoing causes of stenosis were undoubtedly (judging from another set of statistics) the causes of a heavy toll of mortality in other cases that did not have chronic laryngeal stenosis, because they died.

Hasty operation. This is usually the result of one or both of two things:

a. Postponing the operation too long. We all preach doing it early; but almost always do it late.

b. Attempting to give a general anæsthetic which precipitates arrest of respiration.

Hasty operation results in doing a high operation because the upper part of the trachea is more superficial; and all operators have in the recesses of their memories the faulty textbook teaching about the ease of high operations as compared to low operations; worse still they have recollections of instructions as to stabbing of the cricothyroid membrane, either with a knife or a special trocar-cannula of some kind. Had they been properly taught the equally rapid two-step, finger-guided operation, the patient's life could have been saved and he

would have run no risk of a chronic laryngeal stenosis. Hasty tracheotomy often leads to hacking the trachea. This results in islands of cartilage that in the necessarily infected wound are apt to become necrotic. If the ring-like support of the cartilages is lacking, the subsequent cicatricial contractions are unresisted, and this lack of resistance contributes one of the most difficult problems with which we have to deal in the cure of cicatricial laryngotracheal stenosis. In many of the cases coming to the bronchoscopic clinic for relief of chronic laryngeal stenosis, the tracheotomy had been done after the patient ceased to breathe and, hence, was a brilliant and life-saving procedure deserving of the highest praise; and the author would never sanction detracting in any way from the commendation justly due the particular operator. Yet having done many such emergency tracheotomies himself, the author feels justified in repeating what he has stated before, namely: that so far as rapidity of performance is concerned, nothing is gained by attempts at a stabbing operation through the cricothyroid membrane, nor, indeed, by any form of high operation. Were his experience limited to his own tracheotomies or even to those of his various assistants, he would not for a moment think of making such an assertion; but he has the testimony of hundreds of students whom he has taught his two-step, finger-guided operation. When the emergency came to many of these students, they saved the lives of their patients by an equally quick operation that, being low in the trachea, did not leave the chronic stenosis that so often follows the high operation. The technique of the two-step, finger-guided operation has been previously described a number of times,[1] hence does not need repetition here; but in passing it may be said that it rests fundamentally on making two incisions, the first of which splits open the entire front of the neck from "Adams apple" to the suprasternal notch; the second incision opening the trachea which has been found by palpation with the left index in the pool of blood that fills the wound. The whole front of the neck being open the trained finger soon recognizes the corrugated or "washboard" feel of the trachea, and the knife is slid along the left index, the trachea being incised by sense of touch instead of sight. The safety of the slicing open of the front of the neck at the first incision depends upon keeping the patient's nose pointing to the zenith and upon memorizing the "tracheotomic triangle,"[2] which enables the operator to push back the danger lines and throw forward into prominence the safety line, in which there is absolutely no danger whatever of cutting any vessel of dangerous size. Such vessels as still bleed can be quickly caught up as soon as breathing has been re-established. So far as aspiration of blood is concerned this is minimized by the low head position; and the patient having no anæsthetic quickly coughs the air passages clear. The two-step, finger-guided operation does not require more than 1 minute and has often been done in less than 30 seconds.

General anæsthesia an error. General anæsthesia, or rather an attempt at it, contributes largely to the badly done tracheotomies that result in chronic laryngeal stenosis. Surgical literature abounds in reports of cases in which the attempt to give a general anæsthetic was followed by arrest of respiration, and a stabbing or other hasty operation saved the patient's life or, alas, only too often failed to save it. The reason for this large and needless mortality is to be found in the erroneous teaching of the textbooks. Of the 30 surgical textbooks examined, all mentioned general anæsthesia; none condemned it. Ten works advised chloroform, which is a highly efficient respiratory paralyzer; two advised morphine, which is likewise a respiratory paralyzer. It should be taught in all the textbooks on surgery and in all the colleges that *to give a general anæsthetic to a patient with obstructive dyspnœa is needlessly to endanger the patient's life.* A dyspnœic patient is depending on the aid of his accessory respiratory muscles. When he begins to pass under the influence of the general anæsthetic he loses the accessory aid

[1] Peroral Endoscopy and Laryngeal Surgery, 1914; Binnie's Surgery, 1917; Proc. Philadelphia Laryngol. Soc., 1913; also various journal articles.

[2] Loc. cit.

Fig. 1. Case No. L. S. 101. Boy, aged 3. The upper scar shows the site of the tracheotomy through the larynx that resulted in laryngeal stenosis. Below the scar is seen the cannular fistula in its proper place, in the suprasternal notch. This second tracheotomy was done as the first step in the cure of the laryngeal stenosis.

and the respiration ceases. So far as pain is concerned, in a patient not narcotic from carbonic acid, infiltration anæsthesia of the skin is all that is necessary. Tracheotomy even when no emergency exists, and all hæmostasis is completed as good surgery requires, should not take more than 5 minutes. Any pain inflicted after the incision of the skin is not greater than that inflicted for a much longer time on every human being in getting a tooth filled and for which no dentist would think of giving general anæsthesia. Five minutes of this degree of pain can be easily tolerated, and is no excuse for taking the enormous risks of mortality on the one hand, or of chronic laryngeal stenosis on the other. In passing, another fact, one that should alone utterly condemn general anæsthesia for tracheotomy, is that it paralyzes during the operation and for a considerable time thereafter, the cough reflex which the author has called "the watch-dog of the lungs." The cough reflex not only prevents the entrance of the potentially dangerous infectious materials and their pabulum; but, as a watch-dog might rid the house of rats that have already entered and multiplied, the cough reflex expels any incipient foci of multiplying organisms. The author is not unaware of the fact that postoperative pneumonias may be of hæmotogenous origin, nor that lobar pneumonia may be a septicæmia with a local manifestation; nevertheless there is such a thing as aspiration pneumonia and every surgeon will agree that infective agents and their pabulum should not be aspirated. Moreover, no one can deny that the cough reflex brings up infective agents and their pabulum. In the face of these facts it is hard to understand why any surgeon should use, or any textbook should sanction, general anæsthesia for tracheotomy. Add to this the undoubted fact that death or hasty tracheotomy, or both, are almost certain to follow the attempt at anæsthesia of a patient with obstructive dyspnœa, it seems that general anæsthesia for this operation should be universally condemned. Injection of the trachea with a cocaine solution is, in the author's opinion, objectionable for one of the reasons given against general anæsthesia, namely, abolition of the cough reflex. An active cough reflex is a great annoyance to the surgeon for a few minutes; but he will, of course, be glad to put up with the annoyance when he recollects that every portion of blood, pus, and secretion that is coughed in his face is just so much less of these potentially dangerous materials that could get in, or remain in the lungs.

High tracheotomy the chief cause of chronic laryngeal stenosis. Of the over two hundred cases of chronic laryngeal stenosis that have come to the bronchoscopic clinic for relief, and that form the basis of the present article, thirty had necrosis of the laryngeal cartilages. These 30 are eliminated from present consideration because the necrosis had probably resulted from the primary diseases, diphtheria, lues, typhoid fever, pneumonia, etc.; hence, they might have had chronic laryngeal stenosis from loss of the lumen-maintaining cartilaginous laryngeal framework. This framework, as we teach the students, is like the buckram in the lapel of the coat; it maintains the shape of the larynx and the laryngeal lumen. Its absence leaves the larynx especially liable to collapse. In this class of cases, however, the tracheotomy is not often at fault. The condition, it is only fair to assume, has resulted from the

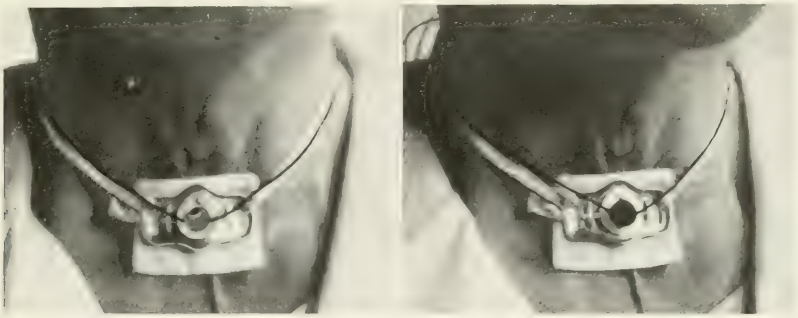

Fig. 2 (at left). Case No. L. S. 102. Tracheotomic cannula in proper position. Above it is seen the scar of the first tracheotomy, which caused the laryngeal stenosis. The cannula is corked with a pure rubber cork in one side of which a groove has been ground to admit some air, the stenosis of the larynx not being yet completely cured. A braided silk ligature is attached to the cork to prevent its being lost when not in the cannula.

Fig. 3. Same case as in Figure 2. Cannula tightly corked, respiration being carried on through the mouth. The cannula being of proper size and properly fitted, there is an abundance of room for the by-passage of air past the cannula in the trachea.

primary condition that required the tracheotomy: perichondritis from trauma, diphtheria, lues, etc., the latter two diseases, especially, being often necrotic processes. Many cases have come in with loss of cartilage due to war wounds. All the cases from the service are of this character, in which stenosis was due to the primary condition, not to the tracheotomy. Of the remaining 170 cases, 158 (93 per cent) had been "high" tracheotomies; 32 of the 158 having been done through the cricothyroid membrane and thyroid cartilage, really through the walls of the larynx itself: laryngotomies, not tracheotomies at all. The ch ef reasons why high tracheotomies result in stenosis, we believe to be these:

a. The larynx, including the subglottic region, is narrower than any other portion of the laryngotracheal airway.

b. The subglottic tissues, in children especially, are intolerant of contact. Wearing of a cannula in this location causes prolonged inflammation and subsequent cicatricial contraction ending in stricture.

c. High tracheotomy usually means, in practice, division of the cricoid cartilage, though in theory it means only that the operation is to be done above the isthmus of the thyroid gland. As elsewhere mentioned, division of the cricoid cartilage means loss of the only complete ring-like support to prop open the lumen of the laryngeal airway. But division of the first ring is also better avoided, because the inflammatory reaction that results from the mixed infections inseparable from a wound accessible to the air leads to stenotic infiltration of the superjacent subglottic tissues, which are not only at the site of a narrower lumen than that of the lower trachea, but the subglottic tissues are of a different character from those of the trachea proper. Prolonged wearing of the cannula will result in a larger, more intractable spur on the posterior wall above the tracheal cannula, in the high than the low region. To come down to the matter of statistics, in the entire 34 years of the author's experience with laryngeal stenosis, there never has been, to the best of his recollection, a single patient sent in with a chronic laryngeal stenosis due to a low tracheotomy. In all of the cases in which a low tracheotomy had been done the stenosis could be justly attributed to the primary condition that had rendered the tracheotomy necessary. As a matter of fact relatively few low tracheotomies have come at all, a fact that bears two interpretations: (a) Most tracheotomies are postponed until emergency requires a hasty operation, which to most men calls particularly for a high operation; (b) the advisability of low tracheotomy (below the second ring)

has never been taught with sufficient emphasis One of the worst features about the classical teaching of a high and a low tracheotomy is that it leads the operator, especially if he is not a trained surgeon, to think of a high and a low skin incision; whereas in any tracheotomy, high, low, preliminary, emergency, formal, or any other kind, the whole front of the neck should be split open in the middle line from the thyroid cartilage to the sternal notch, and the trachea should then be laid bare for selection of the proper site for incision. A long incision in the overlying tissues makes the subsequent finding of the trachea, at operation and during the after-care, easy; a largely open wound prevents mediastinal emphysema, and mediastinal infection. A small wound, like one sutured up close to the cannula, introduces dangers in the after-care and invites complications.

Cricoid cartilage should never be cut. Of the thirty surgical textbooks examined, not one warns against dividing the cricoid cartilage. Anyone examining the cartilages of the larynx will see at a glance that the strongest factor in maintaining the laryngeal lumen is the cricoid cartilage, which is a complete ring; whereas the thyroid cartilage, which rests upon it, is incomplete posteriorly. Our clinical experience has been that other factors being equal, the laryngeal stenoses with a perfect cricoid are the easiest cured.

Is high tracheotomy a justifiable operation? In answer to the question raised at the beginning of this article, the author's experience, to various phases of which reference has been herein made, leads him to state that while no one has the right to say that in any given case, the operation that has saved the patient's life was an unjustifiable one; yet in view of the fact that other methods are equally quick, safer, surer, and not so likely to be followed by laryngeal stenosis, high tracheotomy should not be *taught*. There should be taught but one tracheotomy, and that should mean incision of the trachea lower than the first ring, after splitting open the front of the neck. If for haste or any reason a higher operation has been done, a cannula should not be worn in the high incision; but as soon as the patient has re-established his breathing, the front of the neck should be split open and a second incision should be made below the second ring and the cannula worn therein. The first incision should not be allowed to be covered by the tissues until the cartilages have been united by inflammatory tissue. If any of the various trocar-cannulæ for quick high tracheotomy have been used, the same statement applies.

After-care. Numbers 5, 6, and 7 of the above listed tracheotomic causes of chronic laryngeal stenosis may be grouped under after-care. Next to the error of high tracheotomy, after-care of a tracheotomic case seems less understood than anything else in surgery. A general plan of after-care has been elsewhere given.[1] Only a few points need be referred to here. The wound should be dressed every hour, at least, so as to get rid of the secretions that otherwise would furnish a nidus for saprophytes and other bacteria. The latter will be washed away by the flow of serum and secretions if the dressings are renewed often. The wound should be left open, not sutured up to the cannula. We are not concerned in this article with the general dangers of mediastinal emphysema, mediastinal infection, slow asphyxia from a cannula being misplaced after cleaning or lifted out by swelling of the overlying tissues; but with the tendency to slow union of the divided tracheal cartilages. The union is always fibrous, never cartilaginous, and this takes time. Primary union of the overlying soft tissues will often take place promptly; but the cartilages of the trachea, exposed as they are to air infections, never unite or heal by first intention, and are slow to heal over the divided ends when a cannula is used. Exuberant granulations almost always fungate into the trachea, and linger for weeks or months, after the cannula is removed, in temporary preliminary tracheotomies, often ending in a tracheal stenosis complicating a laryngeal one. The wound in preliminary temporary tracheotomies should be kept open with packing until the tracheal cartilages are united by fibrous tissue and the granulations have epithelialized. In cases in which the cannula is to be worn, the wound should be kept open until the divided ends

[1] Loc. cit.

of the tracheal cartilages are covered with epithelialized granulations. Another defect in the usual after-care is the neglect of ordinary cleanliness of the cannula and the wound. The inner cannula should be cleaned hourly or oftener if obstructed. The outer cannula should be removed at least once a day, cleansed, smoothed, polished, sterilized, and fitted with clean tapes. For this daily toilet, duplicate cannulæ should be provided. It seems strange that a surgeon who would not think of not removing his artificial denture at least three times a day, has been known to tell his assistants or the patient that once a week or once a month is often enough to take out the outer cannula. Patients of refinement often come in with a foul smelling cannula from such neglect of ordinary cleanliness. Corrosion and roughening of the tube with decomposing secretions cause chronic localized tracheitis which in time means fibrosis and stenosis, usually, though not always, located on the posterior wall of the trachea.

The prolonged wearing of an improper cannula is often a factor in the development of a chronic tracheal stenosis. Of course the wearing of a cannula is a necessity; but a proper one, smooth, of proper material and properly fitted in shape and size to the patient, has little or no tendency to result in the localized fibrosis that causes stenosis. On the other hand, one that fits badly, or one made of improper material, as aluminum, hard or soft rubber, or one made with the utterly useless fenestra, will cause irritation and subsequent stenosis. The fenestra is useless because a proper cannula, equal in area of cross section to that of the average normal glottis of the particular patient, will have room around it in the trachea to permit an ample by-passage of air, without any fenestra. Roughly, the normal tracheal area of cross section is more than double that of the normal glottis; hence it is unnecessary to have a cannula of more than half the area of cross section of that of the trachea. Many children are brought to the clinic with tracheal stenoses difficult of cure because, in the haste of operation, an adult cannula was put in and not replaced by a proper size afterward. Wearing the oversized tube had caused ulceration of the mucosa, perichondritis, and necrosis of the tracheal cartilages. Often the cannula is worn unnecessarily long because the attendant is not familiar with the partial corking method[1] of weaning the child away from the cannula. Breathing through the neck is so much easier than through the mouth that after a while the child does not want to abandon the cannula, and with the vivid memories of repeated partial asphyxias, becomes panic stricken when an attempt is made to remove the cannula. Partial corking, permitting air leakage through the cannula prevents panic and will quickly decannulate any child who has a sufficient laryngeal airway.

SUMMARY

1. The most frequent cause of chronic laryngeal stenosis is high tracheotomy.

2. While in a given case no one has any right to say that the operation that saved that patient's life was an unjustifiable one; yet, equally rapid methods being available, high tracheotomy should not be *taught*.

3. The classic distinction between a high and a low tracheotomy with reference to the isthmus of the thyroid gland is a relic of the days when too much respect was had for the thyroid gland, or at least for its isthmus, and the distinction should be abandoned. The vitally important matter of where the trachea should be incised should not depend upon the negligible isthmus. There should be taught only one tracheotomy and that should be low.

4. The trachea should always be incised lower than the first ring except in those rare cases in which laryngoptosis renders this impossible without entering the anterior mediastinum.

5. The cricoid cartilage should never be cut unless laryngoptosis places all the rings of the trachea below the upper border of the manubrium, which would require entering the mediastinum if the rule were to be followed.

6. The tracheotomic causes contributing to chronic laryngeal stenosis are:

a. High tracheotomy.

[1] Peroral Endoscopy and Laryngeal Surgery, 1914, p. 645.

b. Hasty operation.

c. Attempts at general anæsthesia.

d. Cutting of the cricoid cartilage.

e. Hacking the trachea by several incisions instead of one.

f. Denuding the tracheal cartilages of perichondrium with resultant necrosis.

g. Suturing the wound.

h. Prolonged wearing of a cannula that is of improper size, shape, or material, such as rubber or aluminum, or one with a fenestra, or one without a pilot.

i. Neglect of proper after-care. The keynote of the after-care should be that it is a plumber's job; the "pipes," natural and instrumental, must at all times be kept clear.

7. If in an emergency a high incision of the trachea has been made, a cannula should not be worn in it. As soon as the patient's breathing has been resumed a low incision should be made and the cannula should be inserted therein.

8. Going deeper, the fundamental cause of so many cases of chronic laryngeal stenosis lies in the faulty teaching in the surgical textbooks. The eminent surgeons who write textbooks would not do a tracheotomy through the larynx to avoid the isthmus of the thyroid gland, or because of haste; but eminent surgeons are not often at hand when emergency tracheotomies are required. These operations are usually postponed until respiration has ceased. If not already stopped the practitioner promptly stops it by attempting to give a general anæsthetic.

In conclusion, the author apologizes for the foregoing constructive criticism of the modern surgical textbooks that have perpetuated the errors of the ages, and offers as palliation the excuse that his life has been largely spent in combating the chronic laryngeal stenoses that have resulted from errors unconsciously committed in faulty, though often life-saving, tracheotomy. And if the language seems to anyone unnecessarily vigorous, his attention is called to the fact that previous milder statements to the same effect have been ignored, utterly failing to check the steady stream of needlessly-created chronic laryngeal stenoses pouring into the clinic. Perhaps, too, the vigor comes as the venting of pent-up thoughts that could be communicated neither to the patient nor even to the respective tracheotomists who had saved the patients' lives. The fault lies not with either of these classes of individuals, but with the surgical textbooks of today, which perpetuate a faulty teaching.

IMMUNITY IN SURGERY[1]

By GEORGE E. ARMSTRONG, C.M.G., M.D., LL.D., D.Sc., F.A.C.S., Montreal, Canada

TWO of the three fundamental problems of surgery, the application of the ligature and anæsthesia, are established on a fairly satisfactory basis. The third immunity demands further study and investigation. The practical importance of recent advances in our knowledge of immunity gives promise of a more thorough understanding of this complex problem in the near future.

In the words of Professor Oertel, fundamental changes in the conception of cell life and cell activity have recently come about through the development and application of physical and colloidal chemistry and a greater refinement in our knowledge of the morphology of cell structure. Primarily of interest to the biologist, physiologist, and pathologist, they have emerged from the lines of theory and pure science and reached a point of practical importance.

It is not my purpose to enter here into a detailed discussion of all the phenomena of cell life as at present conceived, but it seems serviceable to lay before you certain broad generalizations in regard to immunity reactions which are of great interest to the surgeon as well as to the physician.

First, as to the general nature of immunity. It would be, in the light of present knowledge, a mistake to define immunity, as has been done in the past, only as purposeful protection. For we know that not all immunity reactions are protective, as, for example, in anaphylaxis and in that interesting group of diseases which may now safely be regarded as anaphylactic states (hay fever, asthma, many skin diseases, migraine, etc.), and that even in protective immunity certain accompaniments may occur which destroy its protective effect. It is, therefore, scientifically speaking, more correct to define immunity as the sum total of all interactive processes which proceed in an organism when resisting an invasion. Protective immunity is, therefore, only a relative phenomenon, although in the gradual evolution of the species it assumes a growing importance, because only those organisms survive which are endowed with so-called protective reactions, that is, are enabled through manifold endowment to adapt themselves to changing requirements of environment. It is important to remain conscious of this broader conception of immunity, for it places it entirely within the sphere of general biological laws and cell responses irrespective of their desirable or undesirable individual results.

Turning then, secondly, to the mechanism of immunity reactions, we find today very profound changes in our ideas from those which were held only a few years ago. The ideas of Ehrlich which, as we all know, held the whole field for a time, were entirely chemical. He regarded the toxin of bacteria as a definite chemical compound which was neutralized, like an acid by an alkali, or by another chemical compound, the antitoxin, manufactured by the body cells. But we are today very far from regarding this as so simple a process. On the contrary we have learned that the toxin-antitoxin reactions are extremely complicated colloidal phenomena and that toxins and antitoxins are themselves so complex that their chemical entity is quite uncertain. It appears that toxins and antitoxins are very large colloidal combinations, not simple chemical compounds. They are not actually dissolved in the blood, like crystalloids, but rather suspended or emulsified. They unite by selective absorption, and not by simple chemical reactions.

Let me briefly explain this difference (Chart 1). When we have suspended in a medium a number of non-miscible substances (as for instance, colloids in the blood) (*1* and *2*) the surfaces of these substances are in a state of surface tension and work may be done by these surfaces when the tension is able to diminish. At the interfaces of these substances (that is between them) there is, therefore, a local accumulation of free surface

[1]President's address, Clinical Congress of American College of Surgeons, Montreal, October, 1920.

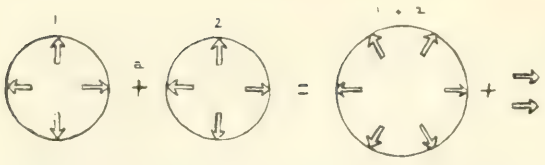

Chart 1. Phenomenon of reduction in surface energy *i.e.*, absorption.

energy and this can be reduced by the deposit of substances with low surface tension at the interface. Consequently, according to a law, formulated by Gibbs and Thompson, it follows that substances which lower surface tension will be concentrated and then precipitated on this surface and the energy will be lessened thereby. Thus colloidal complexes adhere to each other in relation to surface energy. This is, therefore, a physical and not a chemical union, and adsorption is distinct from absorption in which one substance unites with another to lose its identity. Absorption of some colloidal constituents may follow, but this is a secondary matter incidental to adsorption. Adsorption is a very important phenomenon in the relations of colloids and, therefore, also in cell life, and its importance is growing in regard to the relations of the cell to substances with which it enters into combination. Consequently, it is playing a gradually more important rôle in the processes of immunity, for all the substances which we here deal with are colloidal in character. Of this we are certain, although their chemical constitution remains quite obscure. But inasmuch as adsorption in colloids is not, at least not essentially, a chemical reaction, but a physical union, dependent, as we have seen, upon phenomena of surface tension and surface energy only, it possesses a different biological significance from chemical reactions of two compounds. Thus, toxin-antitoxin union is rather a group phenomenon dependent upon physical characters, as contrasted with specific chemical reactions of two substances. It follows, therefore, that immunity reactions are not absolutely, but only relatively, specific. This has been clearly established in the Wassermann reaction and probably also explains the successful cures of certain diseases like rheumatic arthritis, by non-specific, say typhoid, and vaccines. We know that the fixation of the complement in the Wassermann reaction may not only be accomplished by syphilitic serum (that is the so-called syphilitic antibody) but by other colloids (crystals and proteins) of similar physical character. These may occur in the blood after meals, after resorption of extensive inflammatory exudates, in acidosis, and in some other lesions. The opposite has also been established, for withdrawal or solution of these colloids from the blood, as, for instance, through ether narcosis, may render even a syphilitic serum incapable of entering into a positive Wassermann reaction and thus the reaction may be absent in the blood, but still persist in the cerebrospinal fluid. You will at once appreciate the practical importance of these observations, for we must, in order to employ this reaction for the diagnosis of syphilis, guard against the entrance of fat and foreign proteids into the blood which will simulate the syphilitic antibody and we must also interpret the absence of the reaction *cum grano salis* and as influenced by individual circumstances of a case.

Our whole conception of this reaction and its application to practice stands, therefore, today on a very different basis from that of several years ago.

Two other important immunity reactions have recently acquired different explanation and significance: chemiotaxis and phagocytosis.

It will be remembered that these, especially phagocytosis, played an essential rôle in the theories of immunity of Metchnikoff. He went so far as to believe that the ingestion and annihilation of bacteria by cells (phagocytosis) was the principal method of cell defense, and the researches of Wright and his pupils led them to believe that differences in phagocytic action depended upon presence or absence of specific substances, opsonins, which prepared foreign particles for ingestion by phagocytosis; hence the importance of the so-called opsonic index in the blood as index of immunity.

Our ideas have here also undergone decided changes since we know that movement of, and ingestion by, cells are essential surface tension phenomena. Cells suspended in a

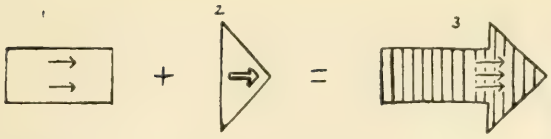

Chart 2. Phenomenon of chemical union. 3, New substance.

Chart 3. Phenomenon of surface tension, *i.e.*, chemiotaxis.

medium behave as do drops of colloids, and their movements and ingestion of foreign particles depend, not upon chemical affinity, but physical changes in their environment.

A drop of a colloid suspended in a non-miscible or only very gradually miscible medium flows gradually toward an area of lessened surface tension in exactly the manner of a cell (amœboid motion). Movement of cells toward an object is, therefore, the result of *lowering* of the surrounding tension in that direction; movement away from an object, of *increase* of surface tension at one of the peripheral points (Chart 2). The cell rests when surface tension is everywhere equal. Positive chemiotaxis (movement to) (leucocytosis, cell exudates) is, therefore, identical with lessened tension in one direction; negative chemiotaxis (movement away) (leucopænia) with increased tension in a direction.

The very important observations of Rhumbler have further demonstrated that ingestion of foreign particles is essentially also a surface phenomenon. We can duplicate the same phagocytic action which we observe in the amœba in a drop of chloroform suspended in dilute alcohol, provided we offer to the chloroform a substance, like shellac, which is soluble in, or "palatable to," it. Solid particles, like splinters of glass and wood, are rejected by the chloroform as by an amœba or leucocyte.

These observations have been thoroughly well established and they make plain the physical basis upon which both chemiotaxis and phagocytosis rest. Opsonic variations are, therefore, not of specific chemical nature, but general phenomena of surface tension variations.

Thus the significance of chemiotaxis and phagocytosis appears in a new light and does away with the necessity of assuming specific chemical processes and particular purposeful vital acts for them.

The physical interpretation of the phenomena of toxin, antitoxin, and complement fixation and those of chemiotaxis and phagocytosis, which I have very briefly sketched, have brought about a greater uniformity and simplicity in our views of immunity, for they make it probable that the multitude of immunity reactions, which were formerly believed to be due to particular chemical substances and processes for each phenomenon and which have brought forth ideas of numerous hypothetical substances and complicated reactions, may ultimately be grouped and explained by the general laws of colloidal relations.

The point of practical importance is that, as our knowledge advances, the many theories which have been introduced to explain individual immunity reactions give way to applications of general physicochemical laws in conformity with other phenomena of cell life.

ACUTE INTESTINAL OBSTRUCTION[1]

By J. M. T. FINNEY, M.D., F.A.C.S., Baltimore

THIS report is founded upon a study of 245 consecutive cases of intestinal obstruction covering a period of the last 10 years. These cases occurred in the general surgical service (158 cases) and the gynecological service (57 cases) of the Johns Hopkins Hospital, and the surgical service (30 cases) of the Union Memorial Hospital, Baltimore. They were not confined to the practice of a single surgeon but represented the combined experience of a considerable number.

Age has seemed to be no important factor in this series except in patients suffering with intussusception and volvulus. Of the 8 cases of intussusception included in this series, all were under 1 year, with the exception of one case, a boy of 13 who gave a history of having been operated upon a short time previously for two congenital anomalies, a persistent thyroglossal duct, and a Meckel's diverticulum which was discovered and removed in the course of an operation for appendicitis.

Of the 8 cases of volvulus, all occurred in patients in middle life, or past. With one or two exceptions, all of the cases occurred between the third and fifth decades of life.

The factor of sex, however, seemed to make a very material difference. The ratio of male to female patients was in the proportion of 2½ to 1.

The race factor seemed also to play a rather important part, since in the Johns Hopkins series, in which both colored and white were included, the ratio was about 1 black to 1.2 white. This, of course, is a far higher proportion in comparison with the numbers of the respective races admitted to the hospital for all causes. Negroes, then, would seem to be more subject to intestinal obstruction than are whites. The reason for this is probably the high percentage of pelvic inflammatory diseases among the women of that race, since in this series the proportion of females to males in this race was 5 to 4 (64 per cent).

Out of the entire number of 245 cases, 217 were operated on, of which 141 recovered, a mortality rate of 36 per cent. The operations varied from such simple procedures as the untwisting of a volvulus or division of a constricting band to resection of several feet of gangrenous bowel. In studying the different operations performed and the circumstances under which they were done, the result seemed to depend far more upon the condition of the patient at the time of the operation, the length of time that had elapsed since the onset of the symptoms of obstruction, and the condition of the bowel, than upon the nature of the operation itself. Other things being equal, the cases of resection seemed to compare very favorably with the simpler forms of operation. In 117 cases in which the condition of the patient at the time of operation was definitely stated, it was said to be good in 49 as against bad in 68. This would seem to have a very definite bearing on the end-results, as well as to furnish a striking commentary on the effect of delayed operation. In 19 cases, no cutting operation was performed as medical measures, enemata, etc., sufficed. Of these, 17 recovered and 2 died. The reason stated for failure to operate upon these two was a practically moribund condition.

The interval of time between the onset of the symptoms and the operation varied very materially in the acute cases as well as in the chronic. In the latter, it extended in several instances over a period of years. In the acute cases, the shortest interval was 4 hours. The shortness of the interval of time elapsing between the onset of the symptoms and the operation played a most striking part. Of 21 cases, all of acute complete obstruction of various kinds, in which the operation was performed in 12 hours or less from the beginning of the trouble, there were 20 recoveries and 1 death, a mortality rate of approximately 5 per cent. The effect of the time element can be still more strikingly seen by observing

[1]Read before the Clinical Congress of American College of Surgeons, Montreal, October, 1920.

the steady increase in the mortality rate which accompanies the lengthened interval. Thus, the mortality rate in the cases operated on in the second 12 hours immediately advances, as compared with the 5 per cent in the first 12 hours, to 11 per cent, while in the cases operated on in the second 24 hours it increases to 31 per cent, a very striking advance.

The obstruction was stated to be complete in 125 cases, incomplete or partial in 85. It was noted as acute in 144 as against 65 chronic obstructions. There were 50 cases of hernia in the list, all strangulated, of which 40 were inguinal, 6 femoral, 3 ventral, 1 umbilical. There were 14 cases of paralytic or adynamic ileus, all postoperative. Of these, 7 recovered and 7 died. One hundred cases, or 40 per cent, of the total number, had had previous abdominal operations of one sort or another, which seemed in some way to bear a definite relationship to the subsequent development of intestinal obstruction. These operations consisted almost exclusively of either appendectomy or drainage of an appendix abscess, or of some pelvic condition, chiefly of inflammatory origin. The mortality rate in the group of obstructions following strictly pelvic conditions was 50.9 per cent, just over one-half, which bears out the generally accepted belief that pelvic operations, especially for inflammatory troubles, are followed by a very high percentage of intestinal obstructions and that the death rate in these cases is correspondingly high. Of the symptoms usually associated with intestinal obstruction, pain was very constant. It was noted in 204 cases (83 per cent), in most of which it was pronounced, of sudden onset, and usually stated as at first "colicky" or intermittent in character, later becoming more continuous. Nausea and vomiting were present in 197 cases (80 per cent). Constipation more or less pronounced was present in 142 cases (58 per cent). Distention was noted in 119 cases (48 per cent) and visible peristalsis in 50 cases (20 per cent).

The operation of enterostomy was performed 48 times with a mortality of approximately 60 per cent. This seems an unusually high percentage, but it was done in this series only in those cases in which operation had been too long delayed, and usually as a last resort, a quick method of affording possible relief with the least expenditure of time and strength for the patient. Resection of the intestine was performed 30 times, as a rule only in severe cases, where the bowel had been seriously injured, or for cancer. It was usually followed by an entero-anastomosis, occasionally by enterostomy, as conditions indicated. The mortality in this group of 30 resections of the bowel was 10 (33 per cent), which would seem to indicate that in cases where the viability of the bowel was in question, and the condition of the patient such as to justify it, resection of the injured segment was the operation of choice, either with or without enterostomy, preferably with immediate entero-anastomosis.

Multiple operations of one sort or another had been performed in 36 cases. In some of these as many as 4 or 5 operations had been done previously.

Intestinal obstruction, generally speaking, is divided into two classes, acute and chronic. This report has to do almost exclusively with the former, although cases of the latter that have occurred in the surgical service of the Johns Hopkins Hospital during the past 10 years, 65 in number, have been included in our series. These include 24 cases of cancer of the colon, 7 cases of tubercular peritonitis and ulceration, 4 of megacolon (Hirschsprung's disease), 1 of which was associated with an imperforate anus, 1 case of sarcoma of the cæcum, and 1 of carcinoma of the jejunum. The remainder were chiefly due to adhesions following previous operations upon the appendix or pelvic organs. The operative mortality in the chronic cases as a whole is high because of the relatively large number of cases of malignant disease included. Exclusive of these, however, it is low because, owing to the long-continued irritation of the intestine, a certain degree of tolerance to insult has become established, which is lacking in the acute cases.

In studying this series of cases and comparing them with other series that have been reported from time to time, such, for instance, as those of Gibson, Deaver and Ross, McGlan-

nan, Woolsey and others, one gains certain impressions, perhaps the most marked of which is that there is a definite relationship existing between the promptness of the operation after the onset of the symptoms and recovery—the shorter the length of time, the higher the recovery rate; the longer the interval, the higher the death rate. Within certain limits, it does not seem to make so much difference what the nature of the operation or who the operator, as *when* it is done. The next thing that impresses one is the difficulty in arriving at a definite diagnosis in many cases. There is one comforting fact however, namely, that practically all of the conditions with which it is likely to be confused, demand operation almost as imperatively as does intestinal obstruction. Finally, one of the strongest impressions that one gathers from this study, and of great practical importance, is that once the question of possible intestinal obstruction has been raised in a case presenting marked symptoms and becoming progressively more grave, immediate recourse, without unnecessary delay, should be had to a surgical operation.

Any part of the intestinal tract may be obstructed and it may be acute, subacute, or chronic. The obstruction may be complete or in part and may be due to a variety of causes, *e.g.*, intussusception, volvulus, foreign bodies, internal strangulation, enteroliths, intestinal parasites, bands, adhesions, kinks, twists postoperative or not, paralysis, tumors, congenital defects, *e.g.*, megacolon, Meckel's diverticulum, etc. Intestinal obstruction may at times be simulated by various conditions, *e.g.*, typhoid fever, Henoch's purpura, certain infections, appendicitis, acute pancreatitis, angioneurotic œdema, the twisted pedicle of a tumor, lead colic, renal colic, gall-stones, mesenteric thrombosis, diaphragmatic pleurisy, etc., and so is not always easy to diagnose.

Acute intestinal obstruction, while not necessarily fatal, is always a grave condition. The gravity is threefold, it is dependent not merely upon the local obstruction to and arrest of the fæcal current, nor yet upon the interference with the free circulation of the blood in the affected segment of intestine, serious as both of these conditions may become by reason of their inevitable sequelæ, but upon constitutional symptoms the result of resorption of poisonous chemical products from the upper intestinal tract. The nature and effect of these substances will be fully dealt with by another in this symposium and are simply referred to here in passing.

The clinical picture of acute intestinal obstruction is fairly constant and characteristic, although not always so, especially in the postoperative cases. In the group of cases developing obstructive symptoms in the course of a few days after an abdominal operation, the purely obstructive symptoms may be masked by those usual in postoperative conditions. The problem here is to differentiate the two conditions, a not always easy or possible task. Fortunately it is not necessary in these cases to make an absolute diagnosis; the important point is to recognize those cases which do not respond to gastric lavage, enemata, and the proper administration of cathartics, and in which the symptoms are becoming progressively worse, and to reopen the abdomen before irreparable damage has been done. In case of doubt, it is always safer to operate. The determining factors are the intestinal character of the vomitus, the failure of lavage and enemata to relieve the vomiting and tympanites, and an increasing pulse rate with restlessness and thirst.

The passage of the stomach-tube in doubtful cases may furnish valuable information as to the character of the stomach contents, and followed by repeated lavage, may be of great benefit. When it is intelligently used, especially in cases of suspected obstruction following shortly after an abdominal operation, it may prove a means of avoiding reopening the abdomen, or may become a veritable life saver.

The most important and common symptoms of intestinal obstruction are pain of sudden onset, constipation, nausea and vomiting, distention, sometimes asymmetrical. Of especial significance is the presence or absence of shock early in the course of the trouble. If the classical symptoms of shock, more or less pronounced, accompany the early mani-

festation of obstruction, one may be reasonably certain that the segment of intestine involved has been pretty badly used, either tightly constricted or injured in some manner, so that its blood supply has been seriously interfered with and its lumen obstructed. Sometimes the development of these symptoms is progressive, mild at first, and gradually increasing in intensity. Such a clinical picture means that the obstruction had been only partial at first but has now become complete.

Constipation is usually present, but may be preceded by one or more movements of the bowels. In our series of cases, it was frequently noted that the bowels had moved soon after the onset of pain and vomiting, thus emptying themselves of the fæcal matter present in that portion of the intestine below the obstruction. After this had been accomplished, constipation developed. Particularly was this observed in the cases where the obstruction was high up in the intestine. This feature was especially well marked in the group of postoperative cases where the obstruction was more apt to be fairly high than in the cases of volvulus, for instance.

Distention is also a fairly late manifestation. It is more pronounced, as a rule, the lower the obstruction, and in such cases is usually symmetrical. Where the obstruction is high, asymmetry is the rule and tympany is less marked.

Visible peristalsis is rarely observed early, and is usually well developed in proportion to the length of time that the obstruction has persisted. The same is true of borborygmus which seems to be associated with at least a moderate degree of hypertrophy of the intestinal walls.

Pain is very constant and usually the first symptom observed. It is more or less pronounced and is intermittent or "colicky" in character, later becoming more continuous and not infrequently of great severity. The vomitus at first consists of stomach contents followed by bile-stained mucus and fluid from the duodenum and upper intestinal tract, later becoming stercoraceous. Hiccough is a frequent accompaniment of this later stage. Tenderness is largely dependent upon the character and location of the obstruction and, therefore, only exceptionally a marked feature. Tenesmus and movable dulness are only occasional accompaniments of this trouble. As the condition progresses, the patient who at first may have shown few signs of serious illness now begins to develop in addition to his pain and vomiting a certain symptom-complex that is very definite; anxious expression, pallor, cold sweat, sunken eyes, rapid pulse, subnormal temperature, dryness of the mouth, severe thirst, scarcity of urine frequently containing large amounts of indican and excessively high leucocyte count. Death usually supervenes in a few days to a week, if operative or other relief is not forthcoming.

When all of the classical symptoms of intestinal obstruction are present, diagnosis is very easy. Unfortunately they are not always manifest. It is by no means always easy to determine the existence, nature, or site of a given obstruction. By careful attention to the history of the case, however, and close observation and study of the phenomena presented, one is usually able to determine the probable presence or absence of an obstruction with sufficient assurance to decide the question of surgical interference, for after all is said and done, this is the only question of vital importance demanding immediate decision. The rest may be left to be determined after the abdomen has been opened or by subsequent developments, as the case may be. Once there is sufficient reason to suspect the existence of intestinal obstruction, one should not wait for the development of a complete clinical picture. Always to wait for a sure diagnosis before operating is sometimes to lose the golden opportunity to benefit your patient. Better a few unnecessary exploratory incisions on live patients, than a continuance of the long and melancholy roll of hurried enterostomies done on moribund patients.

Certain varieties of intestinal obstruction are more difficult to diagnose than others and, at the same time, more amenable to treatment. This is especially true of foreign bodies, such as gall-stones or intestinal parasites impacted in the lumen of the bowel.

Intussusception is fairly easy of diagnosis. The passage of bile-free mucus tinged with blood and accompanied by marked tenesmus and a sausage-shaped tumor in the abdomen of a young child previously healthy, points pretty surely to a case of intussusception. While the sudden onset of colic-like pains in a middle-aged or old person who had previously been troubled with constipation, accompanied by early and very marked distention of the abdomen, suggests strongly a volvulus of the sigmoid.

Among the calamities of surgery is to be classed postoperative intestinal obstruction. After a patient has undergone the mental and physical strain attendant upon a severe surgical operation, and has just begun to feel the satisfaction and physical benefit consequent upon having passed safely through such an ordeal, to be called upon again to submit to further surgical procedures, it may be of even greater severity and more hazardous than before, is to stretch almost to the breaking point the equanimity and fortitude of the patient, as well as to tax to the uttermost his powers of physical endurance. Every operating surgeon sooner or later feels the disappointment and chagrin of such a situation. This experience fortunately does not come so frequently today as formerly, thanks to better methods and wider knowledge. In the early antiseptic days, within the recollection of some of us, when it was the custom to handle the peritoneum none too gently with ungloved hands, to irrigate it with strong antiseptic solutions and to stuff the peritoneal cavity here and there with unprotected iodoform gauze drains, it was a not uncommon experience to see develop during the early days of convalescence from an abdominal operation, symptoms of intestinal obstruction of varying degrees of intensity. Even now in these latter days, in spite of great advances in surgical technique, one occasionally meets with this complication.

Think what it means to the patient, the victim of such circumstances! Think of what it means to the good name of our profession, and what it means in the way of additional anxiety and worry to us personally! It behooves us surgeons, therefore, to exert ourselves to the utmost to prevent such occurrences and to save our patients from having their lives again put in peril, it may be from some error in technique or some fault of ours. Here as elsewhere prevention is far better than cure. It is quite possible, indeed probable, that the occurrence of postoperative obstruction cannot be entirely prevented. It is a common belief that, at least temporarily, adhesions take place between adjacent peritoneal surfaces every time the abdomen is opened. Probably the most of these adhesions absorb, or in some way disappear in course of time in those cases where there is prompt and complete healing. Where, however, there is a continued irritation, for instance, a low grade inflammation from whatever cause, these adhesions will not disappear but will be found to have become organized, and often dense fibrous bands will result. These are a not infrequent cause of the obstructions occurring late. The early ones are due to localized peritonitis, the result of infection of the wound tract, or not infrequently to foreign bodies such as drains inserted at the site of the operation. These drains, especially unprotected absorbent gauze stuffed in large quantities into the wound, are productive of extensive adhesions along the drainage track and which in turn, under favoring conditions, may give rise to intestinal obstruction.

Statistics vary in different clinics but it is safe to say that approximately one-half of the cases of intestinal obstruction occurring in both hospital and private practice have their origin in adhesions resulting from previous operative procedures. Why is this? Is it because of the circumstances inseparably connected with any mechanical procedure involving the opening of the abdominal cavity and the handling of peritoneal and raw surfaces? Or is it inherent in the very conditions themselves necessitating the abdominal operation? Is it due to faulty technique, giving rise to undue trauma of the tissues, or to infection or the presence of foreign bodies, such as drains left in the tissues and causing continued irritation to the peritoneum, or to some combination of these forces? So far, there has been no satisfactory explanation

of some of the phenomena observed. Everyone is familiar with the fact that in many cases where one could reasonably expect adhesions to form, few, if any, do, while in other cases, without apparent reason, many and dense adhesions form and persist. Whatever may be the real reason for this, it is probable that the two most potent factors at work are the presence of a persistent low-grade inflammatory process, the result of infection and the presence of some foreign body in the tissues. The potency of the latter factor is abundantly proven not only experimentally but by the marked reduction of late years in the relative number of post-operative cases as compared with formerly, due largely to the better observation of fundamental principles, *e.g.*, gentle handling of tissues, surgical cleanliness, discontinuance of the use, as drains, of large amounts of unprotected gauze and repeatedly removing and replacing it, thus causing unnecessary insult to the tissues and stimulating the formation of excessive scar tissue.

This fact should be borne in mind at all times by the surgeon in performing any kind of an abdominal operation. By so doing, undoubtedly a certain proportion of cases of subsequent development of troublesome post-operative adhesions and paralytic ileus may be prevented.

Not much dependence can be placed in artificial aids, such as the application to the peritoneal surfaces of ointments or membranes and the like. Frequent change of position after operation and the early establishment of peristalsis by means of pituitrin promise more, perhaps, than anything else at present.

Paralytic or adynamic ileus in some degree is probably of more common occurrence than is usually believed to be the case. Fourteen cases more or less well marked were observed in this series, all postoperative, and all following operations upon the appendix or pelvic organs. Differential diagnosis between paralytic and mechanical obstruction is not always easy. Operations upon the kidney and urinary tract are generally believed to be especially subject to this sequel. At first, these cases do not look especially sick, abdominal pain is not marked, nor is the pulse rate much increased, nor is there any evidence of shock. Vomiting is early pronounced but does not usually persist and is regurgitant in character with little or no nausea. The vomitus is at first copious and consists of fluid mixed with mucus, later of intestinal contents with a fæcal odor. After several days, in the favorable cases, the vomiting reappears, which is always a favorable sign, as indicating a beginning re-establishment of gastro-intestinal activity. The pathology of this condition is still in doubt. But the character of the anæsthetic used formerly considered of importance, does not seem to play an important part. Infection is generally believed to be the most constant etiological factor, but it has not been our experience. The picture in the well developed cases is rather that of a true paralysis of the sympathetic nervous system.

Finally, let us be fair with our patients and ourselves. It is foolish to say, as one hears sometimes, that under no circumstances should any form of cathartic or morphia be given in intestinal obstruction. In this series, 17 cases (6.9 per cent), in which well marked symptoms of obstruction were present, recovered under medical treatment without operation. It does not do to generalize too much. The problem that we, as surgeons, have presented to us is this: to differentiate the cases that do not need surgical operation from those that do, and to give this latter class the benefit of surgery at the earliest possible moment, and not to subject the former class to an unnecessary operation. This can only be done by a careful study of each case by itself and by the exercise of due care and discretion in the use of the less radical measures until convinced of their inefficiency. This will call for the exhibition upon the part of the surgeon of that rarest and highest of all qualities, good judgment.

CONCLUSIONS

1. Difficulty may be experienced in making a diagnosis, especially in postoperative cases.
2. Definite diagnosis is not necessary before operative measures are begun.
3. Early diagnosis is the most important factor in the whole category. It is better that

the operation should be done early than well. Better a poor operation done on a patient in good condition, than a good operation done on a patient in poor condition.

4. One is too largely influenced perhaps, in delaying operation in the postoperative cases, by the fact (a) that the patient has just gone through a major surgical operation and both he and the surgeon dislike exceedingly to submit again to that trying ordeal; (b) that so many cases, comparatively, have symptoms strongly suggesting intestinal obstruction, especially after certain forms of abdominal operation, and recover completely after rest, gastric lavage, starvation, enemata, and medical treatment, that the temptation is strong to postpone the operation unduly in the hope that relief may be afforded through these means. Hence often valuable time is lost in this way, and when operation is finally decided upon, it is too late.

OBSTRUCTIONS OF THE COLON AND ILEOCÆCAL REGION[1]

By CHARLES H. PECK, M.D., F.A.C.S., New York
Surgeon to the Roosevelt Hospital

IN reviewing the work of the second surgical division of the Roosevelt Hospital since January 1, 1910, a total of 9,268 operative cases, we have found records of 138 cases of obstructive lesions of the colon and ileocæcal region. This represents a service of approximately 1,050 operations a year, the diminished total being due to the fact that during the war for a period of 19 months the entire operating staff of the division was in military service, mostly overseas, and the division as such ceased to functionate, the work of the hospital during this time not being included in this report. Lesions of the rectosigmoid and rectum are excluded, the gut from the terminal ileum to and including the sigmoid only, being considered. The cases fall naturally into two main groups: non-malignant, 103 cases; and malignant obstructions, 35 cases.

I. *The non-malignant* may be subdivided into—

	Cases
1. Postoperative conditions	26
2. Postinflammatory and congenital bands and adhesions	58
3. Diverticulitis	8
4. Tuberculosis of cæcum or colon	8
5. Megacolon	3
Total	103
6. Herniæ of colon (obstructed or strangulated cases, number not compiled).	

Of the 26 postoperative cases, some presented serious conditions, difficult to deal with by secondary operation, but there were many in which the procedure was easy, and the outcome satisfactory. One patient had had six previous operations, beginning with appendicectomy and repair of the ileocæcal valve. One of the later procedures consisted in the formation of a jejunosigmoidostomy with an opening at least 3½ inches long and subsequent great loss of nutrition. We have operated twice on this case, the first time taking down the jejunosigmoidostomy and short circuiting a tight stricture of the ileocæcal valve; the second time doing a resection of the right colon for narrowing of the short circuit opening and complete occlusion of the normal ileocæcal opening. The loss of nutrition and the obstruction have been relieved, but a small fæcal fistula and much abdominal pain and general misery persist. Another case presented such a tangle of adhesions involving the ileocæcal region and ascending colon, with obstruction, that resection was performed, the operation proving so prolonged and difficult that death from postoperative pneumonia resulted.

In contrast to the difficult type, we have met with many cases in which division of omental or peritoneal bands has been comparatively easy and free from risk, and encouraging relief of symptoms has followed the secondary operation. Omental bands were

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present in 22 cases of this group, and peritoneal and intestinal adhesions in all.

It has been our belief for many years that iodine, swept into the abdomen from the skin surface by the hands of operator or assistants, was responsible for many postoperative adhesions that would not have otherwise occurred and we have previously cited cases which would tend to support this view. Recognition of this cause as a possible factor in peritoneal irritation and adhesion formation, proper routine towel protection to the wound edges, and frequent rinsing of the gloved hands (not in bichloride solution) before handling peritoneal surfaces, should eliminate this danger.

A common type was adhesion of omental bands to the peritoneal surface of an abdominal wall cicatrix, to the pelvic organs or the gut and parietes in the right iliac fossa. These bands tend to shorten and thicken as time passes, and in addition to direct pressure on portions of the gut, the drag on the transverse colon and its fixation constitutes a real symptom producing lesion. Pain is apt to predominate over symptoms of obstruction, but the normal action of the colon is seriously interfered with. We have found this a definite factor in the pathology of 19 postoperative cases and 4 which had had no previous operations. Postoperative peritoneal bands and adhesions are multiform in type and difficult to classify, but most commonly affect the terminal ileum and ileocæcal region. They range in severity from the difficult type already referred to, to simple cases, easily corrected. The presence of fæcal fistulæ or intraperitoneal abscesses, greatly complicate the secondary operation. We have performed two successful ileocæcal resections for such cases, but the procedure was difficult. There was one death in the series from postoperative pneumonia (the case already referred to).

II. *In pre-operative* group, we have found—

1. Postinflammatory omental and intestinal adhesions;
2. Jackson's membrane;
3. Lane's kink;
4. Peritoneal bands obstructing the colon in which no previous inflammatory lesion could be demonstrated;
5. Adhesions associated with a Meckel's diverticulum.

The omental bands were of two general types, the first of the type described in the postoperative cases, fixing and dragging on the transverse colon, or constricting parts of the intestine.

The second group we believe to be a distinct pathological entity, occurring most often perhaps, but not always, in obese patients. In this type the right lateral portion of the omentum is adherent to the line of the ascending colon and cæcum, and the right lateral parietes. There were eight of these cases in our series. The omentum appeared thickened and contracted as though the result of a chronic infection or irritant, probably originating in the colon itself. The difference between the affected part and the normal central and left lateral portions was striking. Pain and discomfort were the predominating symptom, though there was also marked interference with the action of the colon. This type is capable of producing symptoms of sufficient severity and persistence to warrant operative interference, when no other lesion is present.

There were in all 38 cases of omental adhesions, 16 not previously operated upon and 22 postoperative; 23 of which were associated with intestinal adhesions of varying extent.

Jackson's membrane and Lane's kink. We have noted 25 cases of Jackson's membrane and 29 cases of Lane's kink. In 4 of the cases both conditions were present. These were chiefly culled from observations in 439 personal cases of chronic appendicitis, in which, during the past 5 years, systematic examination has been made for bands of this type. Only cases in which the bands were sufficiently short and tense to produce real partial obstruction were recorded. The typical Jackson's membrane we found to be short, tense, peritoneal bands, usually attached to the ascending colon at its anterior longitudinal band, fixing and constricting the gut to a varying degree and rotating it to the right on its long axis, often from 60° to 90°. No one who has seen the colon snap forward into its normal position on division of these bands, can doubt the real obstructive nature of this lesion, nor its interference with normal propulsive peristalsis.

Lane's kinks vary from the types which produce only moderate fixation and angulation of the terminal ileum to short tense bands which seriously interfere with the function of the gut. While we do not believe in exaggerating the importance of these two types of bands, we do feel that they are definitely obstructive and pain producing in a certain number of instances, and that systematic examination for them should be made in all operations for chronic appendicitis, or explorations of the right abdomen.

We have seen a few cases of abnormal peritoneal bands apparently congenital or not directly due to inflammatory processes, crossing the colon in such a way as to produce partial obstruction in the region of the splenic flexure and descending colon. One case of this type, a man 59 years of age, operated upon for gradually developing obstruction which had become almost complete, with great distention, showed such enormous dilatation of the transverse and ascending colon, that the peritoneal coat had cracked in a longitudinal direction in several places. Division of the bands crossing the splenic flexure was followed by prompt and complete recovery.

Diverticulitis. There were 8 cases of sigmoid diverticulitis, verified by operation with 6 recoveries, and 2 deaths from diffuse peritonitis. One of these cases first sought relief for a fæcal fistula in the vagina, which proved to lead through the stump of the cervix uteri, following supravaginal hysterectomy done 12 years before the fistula appeared. In another case a lumbar abscess simulating perinephritic abscess, had formed. Three had extensive diffuse peritonitis when first seen, two being fatal, and in the remaining three local abscesses were drained. Several additional cases were recorded in which the clinical syndrome was distinct, but which were not verified by operation.

Tuberculosis of the colon. There were 8 cases of tuberculosis of the cæcum and colon, 3 of which were treated by radical operation, with two recoveries and one death. In one case exploration and excision of a fistulous tract was performed. In two exploration only, as the extent of the colon involvement forbade radical operation. In the two remaining cases the diagnosis of tuberculosis of the cæcum and ascending colon was made, but not verified by operation. Diagnosis is generally not difficult, as the clinical syndrome and X-ray findings are as a rule pathognomonic.

The most favorable type, of which case No. 1455 (well 9 years after ileocolic resection) is an example, is the hypertrophic type, the one most difficult to differentiate clinically from carcinoma.

Megacolon. We have observed three cases of giant colon, only one of which was subjected to radical operation. This case, after an unsuccessful short circuit operation (an anastomosis between the right half of the transverse colon and the lower sigmoid, which remained for 3 years widely open enough to admit four fingers, but failed to relieve the fæcal stasis), came to resection 3 years later with removal of 4 feet of transverse and descending colon and sigmoid, as large as a man's arm, prompt recovery and relief following. It was the greatest bulk of intestine, though not the greatest length, which we had ever removed. Of the other 2, one was observed in the course of an operation for chronic duodenal ulcer; the other in an exploration for supposed organic obstruction. The latter, a physician, now gets along in comparative comfort with the aid of catharsis and enemas.

Herniæ. Herniæ are mentioned in passing only, and the cases in this group have not been compiled or included in the totals. They consist chiefly in obstructions of the transverse colon, in umbilical or ventral herniæ, and cases of very large herniæ in which the obstruction of the colon is only a subordinate part of the pathology.

II. *Malignant neoplasms.* There were 35 carcinomata of the cæcum and colon; excluding the rectosigmoid and rectum, distributed as follows:

	Cases
Cæcum	3
Ascending colon and hepatic flexure	12
Transverse colon	3
Descending colon and splenic flexure	5
Sigmoid	12
Total	35

Cases diagnosed clinically, but not verified by exploration, have not been considered. Of

the 35 cases, 18 were treated by radical operation with 15 recoveries and 3 deaths; a mortality of 16.6 per cent. Of the 15 recoveries, 12 are alive and well at the following postoperative periods:

Years	Cases
10	2
9	2
7	1
5	1
3	1
1 or less	5

Seven or 46 per cent of the cases which recovered from the operation are well more than 3 years. One lived 18 months and died of recurrence. One had a secondary operation for local recurrence 5½ years after the primary operation, dying of the disease some months later. The remaining cases were advanced growths with secondary deposits, two of them with perforations and intraperitoneal abscess, in which only palliative or exploratory operations were possible.

In dealing with malignant growths, those reasonably movable, without metastasis, or with secondary deposits limited to adjacent accessible glands or omentum, should be excised, the general condition of the patient permitting.

Radical excision should not be done without preliminary colostomy in the presence of any considerable degree of obstruction with distention of the proximal gut. While closure of both segments and lateral anastomosis was formerly the operation of choice, end-to-end anastomosis, even in ileocolic resection, is becoming more and more our routine procedure, and we believe gives better results. The Mikulicz two-or-three-stage operation is of great value at times and is employed frequently by some of our operating staff. Short circuit operations may prolong life with a degree of comfort for some months and are useful procedures in selected cases. There was only one such case in our series. There were 8 cases of palliative colostomy, a necessary procedure at times for advanced obstruction, but one which should be deferred as long as possible if there is no hope of later radical operation.

ENTEROSTOMY IN THE TREATMENT OF ACUTE INTESTINAL OBSTRUCTION[1]

By JOHN E. SUMMERS, M.D., F.A.C.S., Omaha, Nebraska

PERHAPS it might not be inappropriate to refer to the history of the surgical attack in acute intestinal obstruction, leading up to the operation of enterostomy as we know it today.

In 1676 Paul Barbette, of Amsterdam, advised opening the abdomen in obstinate volvulus and intussusception.

Nucke, the anatomist, had this operation carried out successfully in a case of intussusception only a few years later.

It was not until 1772 that Renault performed the double operation of gastrotomy (abdominal section), and enterostomy. Briefly, the circumstances were these: "A young man had been operated upon for strangulated hernia under hopeful conditions, when several days after the operation, without any external appearance of the hernia, symptoms of internal strangulation presented themselves. Renault, without hesitation, cut into the abdomen. As he found that the small intestine was strangulated throughout a certain part of its course, he made an artificial anus. The operation was successful: on the twenty-eighth day the fæcal matter passed by its normal outlet; and the wound was completely cicatrized." (Trousseau.)

Although several French surgeons successfully practiced abdominal section for intestinal obstruction in both the small and large intestines, it was not until 1838 that Langier recommended the operation of enterostomy when the symptoms of intestinal obstruction continued after the supposed successful reduction of a hernia. In 1844 this procedure was carried out. As symptoms of intestinal strangulation developed, the next day after the operative reduction of a hernia, Maisonneuve re-opened the hernia wound and established an enterostomy. The intestine was obstructed by a band in the neck of the sac. "There was perfect and rapid recovery." However, it is to Nélaton that we owe the firm establishment of the procedure of enterostomy as a life-saving measure in the treatment of acute intestinal obstruction, and the operation was, and still is, known by his name.

First, in 1858, and again 7 years later, Nélaton successfully performed enterostomy. Both of the patients presented all the symptoms of advanced intestinal obstruction, *viz.*, great abdominal distention, fæculent vomiting, etc. Each patient recovered with the artificial anus closed. The technique of Nélaton's operation is the making of a small abdominal incision in the right iliac region, such as for appendicitis, and suturing into the wound the *first* coil of distended intestine which presents itself. The bowel is either opened immediately, or some hours later, according to the urgency of the symptoms.

This type of operation continued to be performed both for mechanical ileus and ileus complicating peritonitis cases, or following abdominal operations, until it was proven that glass tubes (Paul's) or better still, rubber tubes, could be so tied or sutured into the intestine as to drain the bowel effectively and later be removed, allowing the opening in the intestine to close, thus doing away with the nuisance of an intestinal fistula not infrequently necessitating a second operation for its closure.

In general I think it may be said today that in serious cases of acute intestinal obstruction, surgeons (1) make a primary enterostomy as a life-saving procedure to be followed later, if necessary, by an abdominal section to find and relieve the cause of the obstruction. (2) They do a combined operation, making an enterostomy opening in a coil of distended intestine after the successful removal of the cause of the obstruction; this being done for the purpose of securing a safer convalescence. (3) They have still further broadened the field and a peritonitis ileus is included in the indications for operation; the focus causing the peritonitis is removed

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(as a gangrenous appendix), and through the same incision a coil of distended intestine is opened and drained; the distended intestine is drained through a rubber tube fixed into it by a purse-string suture, and in all instances the first or most accessible coil of distended intestine is selected for this purpose —Nélaton's advice. When there is an acute obstruction in the sigmoid or rectum, a cæcostomy is done in the same way as a life-saving measure and as preliminary to the removal of the cause of the obstruction, particularly if this be a new-growth. Nothing essentially different from what I have written can be found in our textbooks or in the general practice of surgeons throughout the world, and without question the practice is sound. It is rightly claimed that the cause of the high mortality in acute intestinal obstruction (about 50 per cent) is due to the fact that operation for one reason or another is performed too late. This is true, but even when performed late I am of the opinion that the mortality can be greatly reduced if the principle of a properly performed and properly located enterostomy can be carried out.

Victor Bonney in 1910, published a paper advising that, instead of following out Nélaton's injunction, *i.e.* "to open the first coil of distended intestine for the enterostomy procedure," the *jejunum* be opened for this purpose. As I have stated in a recent paper on acute intestinal obstruction, Bonney divides the obstructed intestine into three segments: the lower, middle, and upper; the lower more or less collapsed, the middle containing gas, the upper containing fluid. My experience is that the lower and middle segments contain gas chiefly; the upper segment most of the fluids.

The character of the vomitus indicates the height of the fluid-containing segment; when fæculent, the stomach is the highest part. At first in all types of obstruction whether in the small or large intestine, the vomitus is simply the stomach contents; later, in all types, the vomitus becomes fæculent and the stomach and jejunum are in "the segment of toxicity."

"This upward extension of the limits of the fluid-containing segment is due to a rapid upwardly extending infection of the canal by organisms of the lower intestine." (Bonney.) The current in the intestinal tract has become reversed and the drainage must be established in the highest, fluid-containing segment.

Hugh McKenna, December, 1913, reported some animal experimentation and clinical cases supporting the value of a jejunostomy for the relief of ileus. He used the Bonney technique. The enterostomy was done chiefly on the theory of draining the toxic elements in the duodenum.

Mr. W. Sampson Handley, May, 1915, and October, 1915, in articles entitled "Ileus Duplex," by which he means an ileus due to a pelvic peritonitis secondary to an infection (for example, of the appendix or fallopian tubes), recognizes a paralysis of the pelvic coils of the ileum and of the colon, and recommends for its treatment the making of an ileocolostomy or ileosigmoidostomy combined with a cæcostomy. He discusses fully Bonney's recommendation of a jejunostomy, but prefers his own procedure in the type of obstruction under consideration; he recognizes the worth and possible great advantage of the jejunostomy where the evidence of paralysis of the bowel is marked by great abdominal distention and vomiting. In April, 1916, Mr. Victor Bonney published a paper *again* recommending jejunostomy in intestinal obstruction when the character of the vomitus is intestinal or fæculent, and said the drainage should be in "the segment of toxicity." The positive proof of the value of a jejunostomy in the circumstances is that the drainage of the jejunum causes an immediate cessation of the vomiting. For some unknown reason Bonney, in making his jejunostomy, still adheres to the Nélaton type of enterostomy, a type which frequently requires a second operation for its closure, a type in which the jejunostomy permits of the wastage of stomach nourishment through the fistulous opening. Doctor A. I. MacKinnon, in a paper published in December, 1917, recommends strongly the doing of a simple modern jejunostomy for the drainage of the intestine, such a jejunostomy as is made for the nourishment of a patient. He carried out this opera-

tion for the first time, January 21, 1916 (using a double purse-string suture), and has since done a number of them. His work has been successful and is a forward step. The jejunostomy may be done for advanced cases of intestinal obstruction of any type by using a simple technique: a relatively high left rectus incision for drainage through a large-sized catheter introduced into the jejunum and fastened in position by a double purse-string suture. The catheter comes away after a few days and the opening in the bowel and abdominal wall soon closes. Although I am a strong advocate of this procedure and have practiced it a number of times I feel sure from personal experience that unless the vomitus is frankly fæculent, the drainage tube should be introduced into the highest segment of the bowel that is distended, and not into the highest part of the jejunum if not distended, and this can be recognized if an abdominal section has been made to determine the cause of the obstruction. It can likewise be recognized through a proper incision for the exposure of the jejunum near its origin. If, in a search for the obstruction, the small bowel is found much distended, it can *always* be proved that the coils farthest away from the obstruction are heavy and contain much liquid; that those nearest the obstruction are light and contain mostly gas; the heavy coils should be opened in several places to evacuate their contents, and it is sometimes very wise to fasten the drainage catheter by an invaginating technique, into the highest opening made for relief of the distended gut; the other openings are, of course, sutured.

Local anæsthesia, aided by gas if necessary, should be employed in making an enterostomy.

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THE TOXIC AGENTS DEVELOPED IN THE COURSE OF ACUTE INTESTINAL OBSTRUCTION, AND THEIR ACTION[1]

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WITHIN the past decade, various phases of the problem of intestinal obstruction have furnished a field for extremely active experimental study. Numerous individual workers, groups, and laboratories, have made contributions from the surgical, chemical, physiological, and pathological view-points, and a very considerable volume of work, nearly all of which is American in origin, has accumulated. A glance backward at the state of our knowledge 10 years ago, as compared with today, will yield a good general impression of the results obtained.

It is safe to say that in 1910, beyond the fact that acute intestinal obstruction was a highly dangerous and often fatal condition, there was no accurate knowledge of why or how this was true. Various theories, based on no particular facts, enjoyed varying degrees of popularity. Thus infection, disorganization of the nervous mechanism, and intoxication were jointly or severally held as actual cause of death. With the beginning of experimental research, certain new theories were advanced. Thus Murphy and Vincent (1) came to regard interference with the circulation of the obstructed intestine as a vital factor in the production of the symptoms of ileus. On the other hand, Hartwell and Hoguet (2) arrived at the conclusion that the large exudation of fluid into the lumen of the bowel, with consequent desiccation of the body tissues generally was perhaps the fundamental mechanism which was responsible for the serious nature of obstruction. A more intricate explanation was that suggested by Draper (3), that the secretions of the upper intestinal tract were toxic but normally were neutralized or detoxicated by the mucosa of the lower portions of the tract, and that in obstruction this neutralization failed to occur with consequent absorption of toxic material. Still another view was advanced by Sweet (4), who surmised that some alteration of the activity of the pancreas or its relations to the intestine might be a responsible factor in the serious results of intestinal obstruction.

In a series of publications by Whipple, Bernheim and the present writer (5), a large number of experiments were recorded on the basis of which the following conclusions were adduced. In dogs with obstructed loops of bowel, death results directly from intoxication, and is not dependent upon nervous disturbances, circulatory obstruction, or desiccation. The toxic material found in obstructed loops, when injected with proper technique into normal dogs causes death with characteristic symptoms reproducing the picture seen when the bowel itself is obstructed. This toxic material is formed independent of food substances or of the secretions of the stomach, liver, or pancreas. Certain further conclusions were reached, which have been questioned by other investigators. These will be considered in more detail as they concern especially the nature and origin of the toxic material. The opinions just set forth, however, have been confirmed by many others, are sustained by conclusive evidence, and may safely be accepted as established. So that one may affirm with assurance that the diversified and hypothetical explanations that were invoked 10 years ago to account for death resulting from acute ileus have been supplanted by the scientifically sustained and generally accepted belief that such death is due to an intoxication originating from the obstructed bowel. Obviously this is a step of great importance in both the theoretical and practical consideration of intestinal obstruction.

This brings one to the direct subject of this paper: what are these toxic factors, whence and how are they derived, and what is their effect? The active controversy that preceded the general acceptance of the toxic theory of the cause of death has been succeeded by almost as continuous a discussion of the

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nature and source of the toxins. In the work of Whipple, Bernheim, and the present writer, certain facts about these toxins were established and certain conclusions concerning them were drawn. The facts may be presented briefly as follows. In obstructed loops of intestine, so prepared as to contain no food, bile, gastric or pancreatic juice, there is formed a material that when diluted, autolyzed, sterilized, filtered, and then injected intravenously in healthy animals produces a characteristic effect. This effect is characterized by a profound drop in blood-pressure, general collapse, fall in temperature, salivation, vomiting, and profuse diarrhœa, which is often blood-stained; at autopsy, splanchnic congestion is the conspicuous feature, which shows especially in the villi of the duodenal and jejunal mucosæ. The toxic material is found not only in the intestinal contents, but in the mucosa of obstructed loops. The toxic material is not absorbed from the normal mucosa of unobstructed dogs. From these facts it was inferred that the toxins are formed either from action of bacteria or action of the mucosa or its enzymes, since all other causal agents could be eliminated. Some of the evidence evoked led to the conclusion that the mucosa, from some perversion of its function under obstruction conditions, was the source of toxin production and that the toxin found in the lumen was excreted from the mucosa, whereas the symptoms observed were due to that portion of the toxin taken up by the blood-stream from the mucosal cells direct. This point of view has been sustained by Whipple (6) in numerous publications since the articles referred to above.

This opinion, however, has not been unassailed. Murphy, Brooks and their associates, working at George Washington University, had come to the conclusion that the action of bacteria was the essential agency necessary for the development of toxic substances in the obstructed bowel. This view has been strongly supported by the Dagstedts (7), Moorhead, and others at the University of Chicago. They have published a series of articles bearing upon various questions in the study of experimental obstruction and from one of them the following conclusions may be quoted. "(1) Closed loops of bowel freed from bacteria are compatible with life. (2) Closed loops with bacteria but without tissue necrosis are compatible with life. . . . (5) Experiments do not support the Draper theory of a normal toxic secretion from the duodenum, nor the Whipple theory of a perverted secretion under obstruction conditions. (6) Bacterial activity plus necrotic tissue or the absorption of toxic products resulting from the action of putrefactive bacteria on necrotic tissue is the important factor in the rapid death in simple closed intestinal loops." In an effort to assess the importance of the mucosa in the production of toxins, Davis and the present writer (8) deduced from their experiments the following opinions: The secretions of the normal intestine when fresh are not toxic; this secretion when kept under conditions that inhibit bacterial growth remains non-toxic; this secretion when collected and kept free from external contamination, but incubated so that its own bacterial content may grow, develops *in vitro* within 18 hours, toxic properties producing symptoms like those of fluid from closed intestinal loops. These experiments render it unnecessary to assume the presence of the mucosa itself in the production of toxic material. While the activity of digestive enzyme of mucosal origin could not be definitely excluded, the strong impression was made that bacterial activity in the presence of a protein substrate is the source of origin of the toxins of obstruction.

The exact nature of the toxins has also been a matter of dispute. Practically all are agreed that these substances are derived from the splitting of protein molecules. Sweet, Peet, and Hendrix (4) point out that in the series of degradation products of protein or similar large molecule substances, toxic effects are produced by the proteose groups and the amine group, while the fat-splitting enzymes produce from lecithin the toxic cholines and neurines. They would look, therefore, to find the toxins of obstruction in the class of proteoses, amines, or cholines and incline to the importance of the proteoses. Whipple (6) has steadily maintained that intestinal

obstruction is a proteose intoxication, originating as stated above from a perverted action of the mucosa. He has been able to isolate in a fair state of chemical purity from the loop fluid of obstruction cases, both human and canine, a substance which he has studied extensively. He reaches the conclusion that this is the chief toxic factor in death from intestinal obstruction, that it has the chemical and biological properties of a proteose, and that a degree of experimental immunity can be developed against it. As against this view, stands the opinion of Dagstedt's and their collaborators, who take issue in every particular except the primary one of the existence of a toxin. As a result of their investigation they are led to the opinion that the lethal substances are toxic amines, produced by the action of bacteria on proteins and their split products, and that no demonstrable immunity can be developed against them. Other investigators have reported the finding of neurines and cholines. For one not a physiological chemist to pass critically on these rival opinions is little worth while. It must be admitted that Whipple presents clear and convincing proof of the obtaining of a toxic proteose, and nothing in the work of other workers has contraverted this. The suggestion naturally arises that the rival opinions are in no sense contradictory. From the writer's previous work in association with Whipple, and his more recent work with Davis, the opinion has grown that a whole series of toxic split-products comprising representatives of both the proteose and amine groups is no doubt present in the bowel in intestinal obstruction, and quite possibly active in the lethal results. An interesting side-light is thrown upon the chemical side of the obstruction problem by an article of Abel and Kubota (9) upon an entirely different subject. In a study on the presence of histamine in the hypophysis cerebri and other tissues they suggest that histamine, which may be formed by bacterial action, or otherwise, and which in large doses causes depression of the circulation and shock-like prostration, is daily present in the alimentary tract and plays an important rôle as stimulant for the gastric and intestinal musculature and also as a dilator of capillaries during digestion.

Whatever the difference of opinion as to the precise chemical nature of the toxins produced in obstructed bowel, there is unanimity of findings as to their result. In the original paper of Stone, Bernheim, and Whipple (5), it was reported that when the toxins were introduced into the circulation of normal dogs, there followed a marked and rapid fall in blood-pressure, temperature disturbances, excretion of large amounts of fluid into the intestinal canal, with vomiting, diarrhœa, sometimes bloody, and fatal shock. At autopsy a marked engorgement, due to vascular dilatation of the mucosa of the digestive tract, especially the duodenum and upper jejunum is found. Whipple has continued to study the effects of the toxic substances, with publication, from time to time, of his findings. Of particular interest to clinical surgeons is the recent article of McQuarrie and Whipple (6) describing a definite impairment of the excretory function of the kidney associated with the intoxication of intestinal obstruction. As this impairment, measured by the rise of the non-protein nitrogen of the blood, parallels the degree of intoxication, it furnishes a chemical test of the intensity of intoxication and a possible prognostic indication. It also directs clinical attention toward the question of impaired elimination.

No survey of this subject would be complete without mention of an obvious fact, which is repeatedly referred to in the literature, and used indiscriminately by the proponents of conflicting points of view, each to support his own contention. This fact is that the presence of a toxin is not enough to prove its relationship to symptoms; that *absorption* is quite as essential as *elaboration* in the clinical production of intoxication. Thus Whipple (6, last reference) goes so far as to say that nothing produced within the lumen of the intestinal tract can be directly concerned in the intoxication of intestinal obstruction, because these substances cannot be taken up by the intact intestinal mucosa. Therefore he regards the toxic substances as formed in the mucous membrane under ob-

struction conditions, the part absorbed thence into the blood being the active source of symptoms and death, the part excreted into the lumen being inert so far as the host is concerned, but proof of the elaboration of toxin when injected into normal dogs. The workers at the University of Chicago, Cannon, Dagstedt and Dagstedt (7) believing that the essential toxins are formed in the lumen of obstructed bowel, state that the normal mucosa has a selective protective action against the absorption of such toxins, but that under obstruction conditions, especially with distention, circulatory disturbances, tissue necrosis, etc., absorption does take place with consequent intoxication. South and Hardt (10) working in the same laboratory, were forced to admit that distention and strangulation of the obstructed bowel were not always necessary factors for the development of toxic symptoms. Brooks, Schumacker, and Wattenberg, recognizing that production and absorption are the two elements necessary to intoxication, believe that necrosis and distention are important factors in absorption, though not necessary for the production of the toxin, which is formed in the lumen.

In appraising the evidence concerning absorption these cardinal points stand out. There is a toxin found in the lumen of obstructed bowel. This toxin when injected intravenously in normal animals causes the symptoms of intestinal obstruction. This toxin is apparently not absorbed when introduced into the normal unobstructed intestinal tract. Various explanations of what happens, when the bowel is obstructed, to cause absorption have been advanced, none of which is generally accepted.

The writer, availing himself of a privilege assumed by the rest advocating an explanation, suggests this: The toxins, found in obstruction cases and actually the cause of death when absorbed, if introduced into normal bowel *are* also absorbed. The first of this material absorbed produces the effect noted on injection experimentally, and similar to that recorded by Dr. Abel for histamine; namely, increased tone and peristalsis of the gastro-intestinal musculature. In the normal open gut, this hurries the bulk of the toxic material along and not enough is absorbed to cause serious symptoms. In the obstructed gut, vomiting and increased peristalsis result from the same cause, but the mass of the toxin is not thereby removed. Instead, stasis in the bowel, as in the experiments of Davis and myself, leads to the formation of more and more toxin, more and more of which is absorbed, until symptomatic and finally lethal effects result.

SUMMARY

The following facts concerning acute intestinal obstruction may be stated as generally believed:

1. The cause of death in acute obstruction is a form of chemical intoxication.
2. The toxic chemicals are developed in the process of protein disintegration.
3. The effect of these toxic chemicals is to cause a fall in blood-pressure, temperature disturbances, vomiting, diarrhœa, disturbance of kidney excretion, high non-protein blood nitrogen, delayed coagulation-time of the blood, profound congestion of the duodenal and jejunal mucosa, collapse, death.

The following points are in dispute:

1. The precise chemical nature of the chief toxic factors.
2. The precise cause, bacterial or other, of the protein disintegration that results in toxin production.
3. The precise mechanism of absorption.

The clinical surgeon may derive from all of this experimental investigation the following practical suggestions:

1. A confirmation and scientific reason for the previously generally held necessity of prompt relief of obstruction, and evacuation of the contents of obstructed bowel.
2. The use of the non-protein nitrogen content of the blood as a pre-operative guide to the degree of intoxication and a post-operative guide to prognosis.
3. The postoperative use of all measures that combat severe chemical poisoning, *i.e.* the induction of fluid into the system, the use of heat, the washing out of stomach and lower bowel, and enterostomy opening, if there be one.

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BENIGN GASTRIC ULCER IN A KNOWN SYPHILITIC

A Résumé of the Literature Concerning the Diagnosis of Organic Gastric Syphilis

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SEVERAL noteworthy papers have appeared regarding the various phases of gastric syphilis, but the writer has been unable to discover in the literature, any report of the occurrence of non-specific ulceration in the stomach of a syphilitic although Einhorn (1), Niles (2), Eusterman (3), Morgan (4), and others, have indicated the possibility of such occurrence. Einhorn, for example, reports a case of generalized syphilis with gastric carcinoma and states that syphilitics often suffer from other organic lesions of the stomach which are entirely independent of the co-existing general lues. Niles believes that ordinary ulceration of the stomach may occur in syphilitics with the same frequency as in those who are not infected. And Eusterman reminds us that a gastric lesion in the presence of a positive Wassermann reaction is not necessarily specific.

The history of the writer's case follows:

Mrs. C. P., age 26 years, first complained 8 years ago of nausea while eating with relief after vomiting. She had much gas in the stomach all the time. Pain across the upper abdomen, due, apparently, to the gas, came soon after eating if she did not vomit. Sour, bitter, burning eructations were frequent. Alkalis relieved the gas and the pain. This condition lasted all winter. After a long course of medical treatment she was free of gastric disturbance until 1917, one year after the birth of her baby. At this time there was no vomiting but much gas and distress in the stomach which were relieved by eating. She ate between meals and at night. In 1918, gastro-enterostomy and appendectomy were performed by F. T. Bascom for the relief of a pyloric ulcer and chronic appendicitis. In December, 1918, she reported to her physician, W. D. Wolff, with symptoms suggestive of secondary syphilis. The Wassermann reaction was 4+ and she was given a course of specific treatment. Following the gastrojejunostomy she was free from gastric distress for 7 months. Then the old malady returned with the addition of vomiting. Under a milk diet and bismuth for a period of 2 months she gained in weight and her stomach did not bother her much. A return to solid food, however, brought back the old trouble worse than ever. She had sharp pains at night straight across the upper abdomen when lying on the left side. Also, sudden sharp pain while walking on the street. She ate frequent small meals for temporary relief. Shortly before Christmas, 1919, she began vomiting nearly everything. Vomiting relieved the pain until the hungry feeling came on which forced her to eat and then she vomited again. In February, 1920, she entered the hospital for observation. The roentgenological examination was not informative. Pain precluded gastric analysis.

As the Wassermann reaction at this time was still 4+ she was given a course of intensive treatment by E. R. Sprague. Her gastric distress during specific medication became progressively worse until she vomited even water. One morning she ate a grape fruit and immediately had a feeling in her stomach like "hot water on an open sore." She entered the hospital at once. She had lost 33 pounds in 2 months. The Wassermann reaction remained persistently 4+. Examination at operation April 18, 1920, revealed a small stomach so distended as to require deflation. The pyloric ulcer for which the gastrojejunostomy had been done was apparently healed. A large calloused ulcer of the usual benign type was found on the posterior wall of the stomach adherent to the pancreas. The circular induration surrounding this new ulcer extended upward to the lesser curvature and downward to the artificial stoma. Elsewhere the gastric walls appeared normal.

The base of the ulcer was dissected from the pancreas. After separation of the anastamosis on the jejunal side, the line of union was found to be perfect and the opening uncontracted. The extent of the ulcer precluded simple excision. The pyloric half of the stomach together with some large lymph nodes in the gastrocolic omentum were, therefore, removed. The cut end of the duodenum was closed and the old opening in the jejunum was anastamosed to the gastric stump. Recovery was uncomplicated. Four weeks after operation the Wassermann reaction had become 1+.

Pathological report. The specimen consisted of the pyloric end of the stomach and glands and examination showed a gastric ulcer with fibrous base; chronic inflammatory changes; and lymphadenitis in mild degree.

Smithies (5) stated, in 1915, that syphilis of the stomach was not as uncommon as clinicians formerly believed since 25 cases had been reported in the United States during the past 6 years, whereas previously only about 70 authentic reports from all sources had been made. Smithies feels that this apparent increase in frequency is due largely to the general use of serological tests as a diagnostic aid in obscure intra-abdominal conditions. The 26 cases observed and reported by Smithies occurred in the examination of 7,545 patients affected with all types of dyspepsia.

Morgan quotes Ewald (6) to the effect that 10 per cent of all gastric ulcers are syphilitic, but Morgan is of the opinion that not more than 1 per cent of such lesions are specific. According to Eusterman it is doubtful if syphilis is an important etiological factor in simple gastric ulcer because (1) the two were associated in only one-third of 1 per cent in over 2,500 operatively demonstrated cases of benign gastric and duodenal ulcer; (2) Rosenow's (7) research in regard to the streptococcic origin of ulcers, and (3) lack of evidence that simple ulcer becomes gummatous in the presence of systemic or gastric syphilis. Castex and Mathis (8), on the other hand, hold the extreme view that inherited or acquired syphilis is the exclusive cause of gastric and duodenal ulcers. These observers interpret the periodicity of ulcer symptoms as being characteristic of tardy, inherited syphilis and the nocturnal exacerbation common to syphilitic lesions explains the "night pains" of ulcer. According to Morgan, however, the necropsy findings of Chiari and Stolper (9), in 329 pathologically demonstrated cases of lues were positive for syphilitic lesions of the stomach in only four instances. And Symmers (10) found only one such lesion during 4,480 necropsies.

The gross lesions of organic gastric syphilis are broadly classified by Eusterman into (1) gummata in various forms and (2) diffuse syphilitic infiltration. Eusterman considers as specific only those ulcers which result from the degeneration of a gumma. Smithies groups the pathological types of the malady into (1) diffuse infiltration in the areolar tissue causing thickening and stiffening of the gastric walls; (2) dense groupings of lymphocytes confined to the submucosa and mucosa which produce miliary gummata or coalesce, necrose, and slough to form ragged-edged ulcers, often multiple; (3) single or multiple inflammatory nodules, composed of exuberant connective tissue and lymphocytes which may involve the entire stomach wall producing extensive tumors (ulcerating or non-ulcerating), stenoses, and malformations in contour, and which may develop subperitoneally and peritoneally, resulting in (4) perigastritis with thickening of the stomach wall and dense perigastric adhesions.

Morgan describes the pathology of organic gastric syphilis most simply as originating usually in the form of a more or less circumscribed gummatous deposit or infiltration of the gastric wall. Occasionally such infiltration is diffuse. Later the gumma may break down and ulcerate. Still later the

cicatrization of the ulcer nay produce contraction and stenosis.

Eusterman notes the marked difference in the gross pathology between benign and gummatous ulcers as the latter are always multiple, occur usually at the cardia, the lesser curvature, and especially the pyloric portion of the stomach. There are usually associated perigastric adhesions, proliferative hyperplasia of the gastric walls, and other sequelæ resulting in gastric deformity. Eusterman summarizes the organic changes of gastric syphilis in the statement that a gummatous ulcer, usually multiple, and especially a diffuse syphilitic infiltration with variable degree of contracture (fibrous hyperplasia), thickening, deformity and perigastric adhesions chiefly involving the pyloric segment, is the most frequent pathological condition. Eusterman emphasizes the difficulty of differentiating such findings from those characterizing some types of scirrhus carcinoma, linitis plastica, or sclerotic inflammation secondary to benign ulcer, although the latter two forms are rare. The diagnosis may rest upon exploratory laparotomy or postmortem examination. All cases showed deformity, usually marked, with decrease in the size and contour of the stomach, due to cicatrizing gummatous ulcers or areas of proliferative infiltration in association with perigastric adhesions.

Downes and LeWald (11) describe the gastric lesions of syphilis as localized gummata, either single or multiple, occurring most frequently in the pars pylorica, involving either the lesser or greater curvatures, or both. These gummatous deposits starting in the submucosa and spreading gradually to the other coats undergo infiltration, ulceration, and cicatrization. One portion of the wall may remain infiltrated while another passes on to ulceration or may become cicatricial. Pyloric stenosis may result from the gummatous infiltration, cicatrization of the ulcer, or perigastric adhesions.

The microscopical evidence of organic gastric syphilis consists, according to Eusterman, of marked atrophy of the mucous membrane, hypertrophy of the submucosa, and a thickened muscularis due to dense connective tissue infiltration or fibrous hyperplasia. The blood vessels are invariably obliterated. This obliterative endarteritis and perithelial lymphocytic infiltration are most characteristic of syphilitic tissue. The spirochætæ were not found in the acquired cases.

In a case operated upon reported by McNeil (12) microscopical examination of the removed tissues showed degeneration, particularly of the submucosa and the muscular layers and somewhat marked periarteritis of all the arterioles. The mononuclear elements played almost the entire part in the periarteritis. At the point where attempted healing was suspected, new connective tissue was found. Sears (13) also reports a case operated upon in which the most characteristic thing found microscopically in the excised tissue was a very pronounced lymphocytic infiltration. Downes and LeWald observed in 2 cases the difficulty of microscopical differentiation between syphilitic infiltration and the tubercle.

In this connection Broders (14) reports a case presenting a clinical history suggestive of gastric ulcer or carcinoma with a positive Wassermann reaction. In the resected pyloric third of the stomach were three ragged ulcers. Microscopically, sections from these ulcers showed typical tubercles with characteristic giant cells. A few scattered tubercle bacilli were found in the depths of the ulcers. Some lymph nodes attached to the excised portion of the stomach showed typical tubercles and giant cells under the microscope. Sputum tests were negative. Necropsy revealed evidences of tuberculosis in the left lung without cavity formation. The signs and symptoms of gastric disturbance had completely dominated the clinical picture. Although the Wassermann reaction was positive, the gastric and pulmonary lesions were undoubtedly tubercular. Broders states that no case of tuberculosis of the stomach has been absolutely proven to be primary in the stomach.

Regarding the postmortem microscopical findings in organic gastric syphilis, Symmers noted in a stomach showing extensive ulcerative lesions, chronic productive inflammatory changes with miliary gummata, endarteritis obliterans and circumvascular plasma and round cell infiltration. Although Symmers

found also in this instance, syphilitic changes in the lymph nodes, nevertheless the failure to discover such corroborative evidence does not disprove the specific nature of the gastric lesion since McNeil reported, in an undoubted case of gastric syphilis, merely inflammatory changes in the lymph glands.

Relative to the stage of syphilis in which specific gastric lesions occur. Smithies observes that in 2 patients the stomach involvement appeared late in the secondary stage and in 22 cases the gastric affection was a tertiary manifestation. Eusterman states that of 16 cases the earliest symptoms appeared in 1 year and the latest 28 years after the disease was contracted. The average period was 11 years. Morgan believes that organic gastric syphilis is a tertiary manifestation of lues.

The symptomatology of organic gastric syphilis is varied. Eusterman states that the malady may simulate benign ulcer or carcinoma when in the pyloric region with stenosis and that multiple or extensive involvement with atypical symptomatology may defy diagnosis. "The symptomatology is variable because the pathology is variable. One of the most characteristic features is the absence of definite symptomatology." Morgan believes that there are no characteristic symptoms. Atypical chronic gastric disorders which resist the usual methods of treatment should arouse suspicion of syphilis. Einhorn says: "In making a diagnosis of carcinoma do not forget the possibility of gumma." Clark (15) considers the symptomatology of gastric syphilis so varied that specific treatment should be tried for all cases of stomach trouble before resorting to surgery. And White thinks that the possibility of syphilis should be considered in all cases of gastric and cardiac disease where the symptoms are not clear.

Smithies has classified the 26 cases observed by him into three groups according to the types of gastric histories as (1) instances of persistent gastric derangement in persons who had previously experienced no digestive upset; (2) instances in which a constant dyspepsia followed years of antecedent intermittent indigestion; and (3) instances of continuous gastric upset in those who had been affected gastrically in the past, but who had been for years free from digestive disturbances.

Of interest in this connection is the case reported by McNeil of a man who had suffered for 3 months with symptoms suggestive of benign gastric ulcer. Sharp epigastric pain came on from one-half to one hour after meals with aggravation from acids and considerable weight loss. There was no free hydrochloric acid and the total acidity was 25. The Noguchi test was positive. Rest in bed for 2 weeks under antisyphilitic treatment induced no amelioration of the pain. At operation a marked annular thickening encircling the first part of the pyloric region and enlargement of the pyloric lymph nodes was found. After resection of the pylorus an annular, apparently active ulcer almost completely encircling the first part of the pylorus was observed. The submucosa was most involved. The edges of the ulcer were undermined and soft, and the floor smooth. An attempt at healing appeared at one end. Microscopical examination showed degeneration, particularly of the submucosa and the muscular layers, and somewhat marked periarteritis of all the arterioles. The mononuclear elements played almost the entire part in the periarteritis. The lymph nodes showed simple hyperplasia. Morgan states that ulcer is the most frequent form in which gastric syphilis is recognized.

Niles reported a dissimilar case which presented the clinical and roentgenological picture of gastric carcinoma. There was an acidity, weight loss, cachexia, distress after eating, vomiting, regurgitation of gas, weight in the epigastrium, severe gastralgia, and X-ray distortion due to a new-growth. The Wassermann reaction, however, was 4+. A functional cure followed specific treatment. A relatively small number of cases of this type has been reported. There remains a large recognized group presenting, as explained by Eusterman, symptoms indefinite and variable because the pathology is variable.

The writer believes, therefore, that cases of organic gastric syphilis might well be symptomatically classified as (1) those simulating benign gastric ulcer, (2) those simulat-

ing gastric carcinoma, and (3) those presenting an atypical gastric history.

In a detailed consideration of the gastric syphilis syndrome in 23 cases Esterman notes that the pain which accompanies the scirrhus or infiltrating types comes on immediately after eating and continues until the stomach is empty. Such patients eat small amounts of semi-solid or liquid foods frequently. The pain incident to the uncomplicated gummatous ulcer type, however, simulates that of benign ulcer, being remittent, rather periodic and coming on 1 to 3 hours after meals, but is only slightly or not all relieved by alkalis and food.

Downes (16) observes that, in general, the pain which is a most constant symptom lacks the periodicity of that occurring in the average simple ulcer and is not so much influenced by the taking of food. It is frequently worse at night. Clark also emphasizes the tendency toward nocturna exacerbation in organic gastric syphilis. And Morgan believes that the pains of this malady are always worse toward night. Eusterman, on the other hand, in a series of 23 cases, noted definite nocturnal pain in only 3 instances. Although nausea is unusual Downes and LeWald marked vomiting in all of their 8 cases, and Eusterman observed it in 85 per cent of his series. Rapid, marked weight loss without commensurate cachexia or decrease of strength is frequent. The appetite remains good. Clark noted a tendency toward severe hæmatemesis after a latent course in several instances, and Einhorn reports a case of syphilitic ulcer with profuse gastric hæmorrhage. Eusterman, however, states that hæmatemesis is rare. Smithies mentions its occurrence only once in a series of 26 cases and Downes believes that hæmorrhage is less frequent than in peptic or duodenal ulcer. Observers generally consider anacidity a striking characteristic of organic gastric syphilis. Smithies, however, states that the free hydrophloric acid may be normal or only slightly reduced.

Regarding the palpability of specific gastric tumors Einhorn reports three personal cases in which masses were felt through the abdominal walls. Morgan has palpated a movable pyloric tumor in 2 cases and Downes and LeWald felt a hard, indefinite epigastric mass in one instance. Eusterman palpated a tumor in only one case in a series of 23. Eusterman noted, in several other instances, epigastric masses simulating gastric tumors which disappeared under specific treatment, but these were not clinically and roentgenologically proven to be of gastric origin. Eusterman, therefore, concludes with Hausmann (17) that such masses might be syphilitic lesions of the liver. Morgan believes that the muscle resistance and tenderness elicited by abdominal examination, noted also by Eusterman and others, explains the failure to feel specific gastric tumors more frequently.

The roentgen-ray findings in syphilis of the stomach, according to Downes and LeWald, may be divided into three classes: First, a rather typical, diminished size, and dumbbell-like appearance of the stomach due to deformity caused by infiltration involving the middle or pyloric half of the stomach. The pylorus may be involved and held open so that the stomach empties or begins to empty rapidly as in carcinomatous infiltration. Even though the stomach begins to empty rapidly a trace of food may remain high up at the cardiac end at the sixth hour.

The second type resembles the first but the pyloric involvement or the stenosis of the infiltrated portion of the body of the stomach may cause delayed emptying as occurs in ulcer or carcinoma. In both types the stomach seems smaller than normal with a tendency toward compensatory dilatation of the œsophagus.

In the third type the infiltration may involve only the pyloric region with findings resembling those of cicatrized ulcer and may be accompanied by dilatation of the stomach. Smithies reminds us that the roentgen demonstration of such gastric deformities is not pathognomonic of syphilis since similar abnormalities might be observed in benign or malignant peptic ulcer and carcinoma. Carman (18) also states that "syphilitic hourglass may result either from luetic ulceration or hyperplasia. The hyperplastic or gummatous type with filling defects and a corresponding palpable mass is not roentgenolog-

ically distinguishable from cancer. Syphilitic ulcers are often multiple with a strong tendency to the production of hour-glass. However, the roentgenologist first suspects syphilis rather than cancer from certain clinical facts and not from the roentgen picture. There is no palpable mass, the patient may be under the cancer age, he is anæmic rather than cachectic, and has not lost weight and strength in proportion to the extent of the gastric involvement and the duration of his trouble. Then with a positive Wassermann, the diagnosis of lues is warranted, but hardly otherwise."

In spite of the manifest difficulties, Esterman believes that the diagnosis of organic gastric syphilis usually may and should be made, when occasion requires, without postmortem examination or the microscopical examination of resected tissue. In this opinion Smithies concurs with the statement that the general use of serologic tests as a guide in the differential diagnosis of unusual intra-abdominal complaints is largely responsible for the increasing frequency of recognition of this malady. Esterman observes that the diagnosis is based usually upon a past history of initial and secondary symptoms, on the demonstration of late syphilitic manifestations, Wassermann-Noguchi reactions, and the results of specific therapy.

The Wassermann test is most helpful in differentiating gastric syphilis from simple ulcers and other diseases of the stomach, particularly carcinoma. However, the absence of a syphilitic history and a negative Wassermann reaction does not exclude the possibility of syphilis. Also a gastric lesion in the presence of a positive Wassermann reaction is not necessarily specific. We must, therefore, exclude cases presenting a fairly regular syndrome, with normal or increased acid values, if the gross appearance at operation or the microscopic picture of resected tissue is that of the usual chronic calloused gastric ulcer, or when improvement in gastric function is notable without antisyphilitic treatment. The symptomatology of organic gastric syphilis usually suggests benign ulcer, but the gastric chemistry and the X-ray suggest carcinoma.

Downes observes that the diagnosis of organic gastric syphilis hinges upon the clinical and laboratory findings. In the congenital cases, the family and previous history of the patient, his general development and appearance, with the symptoms of chronic stomach trouble should be suspicious. In the acquired cases the past history plus unusual symptoms should suggest something out of the ordinary. In both types the disease differs from the simple gastric or duodenal ulcer, as it is influenced but little by dieting and the usual treatment, and it is unlike malignancy since there is not the steady, continuous progress to a fatal termination. "A positive Wassermann reaction with roentgenographic findings, of persistent and unusual deformity of the stomach, establish the diagnosis beyond much doubt. The value of antisyphilitic treatment in confirming the diagnosis of syphilis in general cannot be ignored."

Clark states that gastric disturbances which are characterized by chronicity, night exacerbations, anacidity, and gastric achylia, especially if accompanied by a positive Wassermann reaction, are presumably syphilitic. In view of the absence of characteristic symptomatology in organic gastric syphilis, Morgan considers the diagnostic criteria to be the Wassermann reaction and the therapeutic test.

The diagnostic value of such test is generally conceded. For example, a case reported by Einhorn of gastric tumor with a negative Wassermann reaction, which simulated carcinoma even at exploration, was later symptomatically cured by specific medication. And Morgan observed, in several instances, the amelioration of symptoms and the disappearance of gastric tumors which could not be differentiated from carcinoma, under antisyphilitic treatment. Smithies reminds us, however, that too great reliance should not be placed upon the effects of antiluetic medicines since they sometimes favorably influence non-specific conditions. Downes, on the other hand, defends the therapeutic test with the statement that the improvement following its administration is transient in non-specific stomach lesions, whereas in gastric lues, there

is almost immediate and continued relief from symptoms. But it is not an infallible guide since McNeil reported a case which symptomatically resembled benign ulcer although there was no free hydrochloric acid and the Noguchi reaction was positive. A course of specific medication during 2 weeks failed to afford relief. Nevertheless, the tissues removed at operation were definitely syphilitic.

The confirmation of the diagnosis by operative findings is relatively infrequent because, as Smithies reminds us, the treatment of gastric syphilis is essentially medical and, therefore, the diagnosis usually rests upon non-surgical evidence. Nevertheless, on occasion, laparatomy has been done unsuspectingly and the diagnosis made from observation of the gross pathology. Smithies further states that even at operation the diagnosis is often in doubt and that gastro-enterostomy has been performed for the relief of syphilitic gastric ulcer. "Experienced surgeons, however, leave undisturbed the well-delimited, hard, plaque-like ulcers and the firm nodular tumors which arise from a stomach wall already thickened by diffuse, infiltrating, exuberant connective tissue." Einhorn reports a case in which the abdomen was opened with a pre-operative diagnosis of carcinoma of the pylorus, the Wassermann reaction being negative, and a large, irremovable tumor, presumably carcinoma, discovered. Later, specific treatment was tentatively administered with symptomatic relief and disappearance of the tumor.

McNeil and Sears each report a case in which the radically removed tissues were definitely proven to be syphilitic by microscopical examination. McNeil's patient obtained no relief from antileutic medication prior to operation. Downes and LeWald, on the other hand, report a series of 8 cases in which the diagnosis of gastric syphilis had been quite definitely established by clinical, serological, and X-ray examination, but in 2 of the 5 cases which were operated upon, microscopical examination was not conclusive. In one a suspicious nodule from the liver and in the other, a section of the gastric wall, the tissues could not be differentiated from tubercular tissue although the microscopical appearance of the gastric mucosa and submucosa in the latter was rather suggestive of syphilis.

The postmortem evidence of gastric syphilis is meager. Chiari and Stolper discovered only four instances during the examination of 329 syphilitics. And Symmers, in 4,880 necropsies, 314 upon known syphilitics, found but 1 gastric ulcer of indubitable syphilitic origin. There were also characteristic gummatous changes in the liver and lymph nodes and syphilitic aortitis. The extensive ulcerative lesions in the stomach presented chronic productive inflammatory changes with miliary gummata, endarteritis obliterans and circumvascular plasma and round cell infiltration. Symmers, therefore, is not inclined to accept the diagnosis of gastric syphilis unless it is confirmed by microscopical evidence. White (19) observes, in this connection, that the infrequent discovery of gastric lesions after death has led postmortem observers to look askance at the diagnosis of gastric lues, yet the same condition obtained in lesser degree in benign ulcer since the lesion was found most often, at first, by the surgeon.

SUMMARY

Organic gastric syphilis is more frequent than formerly supposed. The gross lesions of gastric syphilis are (1) gummata in various forms, and (2) diffuse infiltration. Specific ulcers result from the degeneration of gummata. Symptomatically such lesions differ from benign ulcers chiefly in the absence of pain ease from food and alkalis, less periodicity, anacidity, vomiting with good appetite, excessive weight loss and improvement in gastric function with specific treatment. Without operation the diagnosis usually rests upon a past history of early syphilis, present late syphilitic signs, Wassermann reactions and the therapeutic test. However, a negative Wassermann reaction does not exclude the possibility of gastric syphilis, and benign lesions of the stomach may occur in a known syphilitic. At operation specific ulcers are always multiple, ragged lesions occurring usually at the cardia, the lesser curvature, or the pyloric region accompanied often by perigastric ad-

hesions, thickened gastric walls, and gastric deformity. Large gummatous tumor masses or cicatricial contractions subsequent to extensive ulceration simulate carcinoma, particularly as regards the type of dyspepsia, the vomiting, the rapid weight loss, and the anacidity, although the cachexia and loss of strength are less than that encountered in malignancy and the course may have been longer. The operative findings consist, usually, of an irremovable gastric tumor mass indistinguishable from carcinoma. The X-ray evidence also simulates carcinoma. The roentgenographic signs of organic gastric syphilis in general consist of encroachments upon the lumen, distortions, and deformities. The microscopical evidence consists of the characteristic syphilitic obliterative endarteritis and perithelial lymphocytic infiltration with atrophy of the mucous membrane and hypertrophy of the submucosa and the muscularis. Postmortem confirmation of the diagnosis is infrequent.

CONCLUSIONS

1. Organic gastric syphilis may simulate (a) benign gastric ulcer, (b) gastric carcinoma, or (c) present an atypical gastric picture.

2. The diagnosis of organic gastric syphilis is often difficult and sometimes impossible.

3. A negative Wassermann reaction does not disprove the existence of syphilis and a positive reaction does not prove that a gastric lesion is specific.

4. The "therapeutic test" is usually reliable but not infallible.

5. The roentgenographic evidence is not conclusive.

6. Exploration may not be determinative, particularly as regards differentiation from carcinoma.

7. Atypical, chronic gastric disorders which are unresponsive to the usual treatment should arouse suspicions of syphilis.

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THE DIAGNOSIS AND TREATMENT OF CHORIO-EPITHELIOMA[1]

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ONE of the most unique tumors in the category of malignant neoplasms is the chorio-epithelioma of Marchand. It represents a truly parasitic growth in so far as it originates from cells foreign to its host and then maintains an independent existence, drawing its nutrition from the tissues in which it is embedded.

I believe at this period all clinicians and histologists will agree that the chorionic epithelium is the origin of the malignant chorio-epithelioma. We find this tumor either intra-uterine or extra-uterine in situation, that it may follow a pregnancy, either normal or pathological, and that the pregnancy is sometimes recent, at other times long past. The period of latency has been reported as long as 9 years. The occurrence of the tumor following labor, miscarriage, or an abnormal pregnancy, such as hydatidiform mole, has been well and often described. Its situation intra-uterine or extra-uterine, either associated or independent, has been thoroughly considered and from the purely clinical point of view there is very little to be added.

The clinical aspect has been accurately described, and while exact in portraying its symptomatology, does not aid in giving a definite prognosis. There are times when the help of the pathologist is asked; often he cannot determine whether a certain tumor will or will not respond to one or another form of treatment or even if the histological picture warrants a definite diagnosis.

The original division of malignant chorio-epitheliomata into two groups, (a) typical and (b) atypical, though seemingly arbitrary, has been well maintained ever since its inception by Marchand. In the class designated typical there is histologically a distinct picture. One finds multinuclear syncytial masses and also groups and plaques of mononuclear Langhans cells showing mitoses and variations in size, shape, and state of degeneration. The extent of participation of both components varies markedly so that one or other elements may predominate, with all the possible graduations. The growth while exceedingly vascular shows a marked tendency to disintegration and necrosis. This type is considered the malignant form.

The second group, the atypical, shows invasion of the musculature of the uterus by syncytial masses or isolated cells and is characterized by the absence of Langhans cells.

Metastases are more commonly associated with the typical chorio-epithelioma and may take place not only in the pelvis and vagina but in all the organs of the body, especially in the lungs. These metastases occur through the blood stream. One of the characteristics of the tumor is its tendency to erode blood vessels and to grow into their lumen. This avidity for the blood vessels makes the problem of metastasizing a simple one to understand (Fig. 1).

On the other hand while the atypical group gives rise to metastases, it is comparatively uncommon and rarely if ever so widespread.

Between these extremes there are many intermediate stages. Histologically we find cases with steadily decreasing numbers of Langhans cells until we arrive at the group where the syncytium predominates and then finally to the above described atypical group with persistence only of the syncytial elements. Villi are found both in the typical and transitional cases and even in the purely syncytial type occasionally villi are encountered (Fig. 2). Their prognostic value is open to question but Ewing believes that their presence has some bearing on the clinical course. In a rather exhaustive article Ewing has attempted histologically and prognostically to classify these tumors according to a more or less definite microscopical picture. In fact he believes that the histological structure of the chorionic tumors and the clinical course can be correlated and that prognostic value may be attached to the microscopical ap-

[1] Work done under tenure of a George Blumenthal, Jr., Fellowship in Pathology.

pearance of the tumor. He groups his types, according to their histological characteristics, under the following names: Chorio-adenoma destruens, choriocarcinoma, syncytial endometritis, and syncytioma.

EWING'S CLASSIFICATION

He reserves the term chorio-adenoma destruens for a type of tumor composed of elongated, hypertrophied villi clothed with actively proliferating cells of both syncytial and Langhans type. Such villi infiltrate the uterine sinuses and enlarge the uterus forming often a polypoid tumor. This tumor tends to remain in the uterine cavity but in many instances extensions occur in the broad ligament and pelvic veins with metastases in the vagina and lungs. The metastases often contain villi. The tumor rarely forms general metastases but produces all the structures of the normal villus in an orderly fashion.

The presence of villi is a reliable ground for classification but more important is the presence of orderly branching buds of vacuolated syncytium and sharply defined Langhans cells of normal type. This destructive polyp offers a hopeful prognosis which Ewing believes differentiates it from the malignant type.

This group he believes is a genuine neoplastic process but more benign in its clinical course than the growths termed choriocarcinoma. (It may be cured by curettage, partial removal, or may even spontaneously regress or be expelled.) He urges a more conservative treatment for this group of cases, such as curettage and only in cases of alarming hæmorrhage with enlargement of the uterus does he advise hysterectomy.

The commonest type of neoplasm arising from the chorion, the typical chorio-epithelioma of Marchand he designates choriocarcinoma. In these cases the chief feature is the absence of villi, very extensive proliferations, and pronounced metaplasia of Langhans cells and syncytium (Fig. 3). They grow diffusely and do not show the orderly arrangement of the milder forms of chorionic tumor. The tumor in the uterus is small, the uterus slightly enlarged, but there may be numerous metastases. In some cases there is an absence of a primary uterine tumor (Fig. 4). In this group the prognosis is bad, the great majority of these cases prove fatal in spite of early operations. In cases of this type with metastases, the prognosis is always fatal.

In reference to this group we feel that too pessimistic a prognosis is made, as we have had several of this type with recovery following operation. In addition we have found cases of typical choriocarcinoma with a few well preserved villi (Fig. 5). These villi we interpret not as a part of the choriocarcinoma *per se* but as the remains of the pre-existing pregnancy that gave rise to the tumor.

A third type coinciding with the atypical chorio-epithelioma of Marchand is called by Ewing syncytial endometritis. In this process the syncytial invasion of the muscularis of the uterus constitutes the whole process. The uterus is diffusely enlarged due to the invasion of the uterine wall and sinuses with large mononuclear or giant syncytial cells. The growth may appear as a more intense variety of the normal infiltration present in pregnancy. The tumor may arise from a large area of the internal surface of the uterus or involve only a relatively small area. It may present itself as one large mass or surround the cavity as irregular globular masses. The tumor itself is composed mostly of blood, fibrin, necrotic tissue, and groups and masses of syncytial cells. In some instances these cells may constitute the most prominent feature of the growth and to this variety the term syncytial chorioma is given. Occasionally metastases in the broad ligament or vagina may arise but they are really deported, regressive villi or syncytium, and not genuine progressive metastases. The prognosis is favorable, and curettage, when the diagnosis is definite, is sufficient.

AUTHOR'S CASES

Choriocarcinoma		
Died—sepsis	1	
Hæmorrhage	1	
Without operation, admitted moribund	1	
Recovered	6	9
Curettings, typical choriocarcinoma	1	
Syncytiomata	2	
Syncytial hypertrophies	2	5
Total		14

I have had the opportunity of studying 14 cases with a view to classifying, as did Ewing, the chorio-epithelioma in accordance with a definite histological picture, and to determine the value of the pre-operative diagnostic aid of the microscope.

Nine cases of the 14 could be classified as choriocarcinoma; of these 3 died. Of the 3 that died 1 developed a sepsis following a curettage and packing, 1 an ectopic choriocarcinoma died on the operating table from hæmorrhage, while the third was admitted moribund with generalized metastases and died without operation. The other 6 recovered. Of the remaining 5 cases, 1 presented curettings that were typical of choriocarcinoma but recovered with no other operative interference. Two cases were typical syncytiomata, and 2 were atypical and are classified as syncytial hypertrophy.

Many of the cases had preliminary curettages for bleeding and this material was studied to determine if an absolute diagnosis could be made. If the diagnosis was determined could we definitely set an operative indication?

Of the 14 cases studied there were 11 in which a previous curettage had been done. In 6 instances the curettage had been performed from 2 weeks to 1 month previously for varying symptoms (mainly bleeding). In three instances there was a report of hydatid mole, in two, fœtus and placenta was the diagnosis, and in one, done at another institution, the curettings were reported miscarriage. Of the 3 instances of mole a further study of the curettings with the knowledge obtained postoperatively would have permitted a diagnosis suggesting chorioepithelioma (Fig. 6). In other words, in these six instances the diagnosis was not made from the curettings, though in 3 it would have been reasonable to suggest the possibility.

In 4 other instances a curettage preceded the hysterectomy by just a few days, because of a history of bleeding. In 3 of these cases an absolute diagnosis was made from the curettings, and on one, where a section of uterine muscle was removed, histological study showed only an invasion by syncytium. This uterus nevertheless was removed because of persistent bleeding but showed no other abnormality. In other words, in 4 suspicious cases a positive diagnosis was made in 3, while the fourth case which did not present a typical picture proved later to be a type classified by Ewing as syncytial endometritis, a group I would rather consider to be a simple exaggeration of the normal condition in pregnancy or a perverted activity of the fœtal cells and not a true tumor. This type will be considered more fully later. Of the three cases diagnosed as chorio-epithelioma, a subsequent hysterectomy proved the correctness of the opinion, each uterus containing a typical chorio-epithelioma of Marchand. The other instance of curettage was a case that gave a typical history, the curettings were diagnosed chorio-epithelioma, but the patient left the hospital against advice and was not heard from again. The diagnosis, therefore, was not confirmed by examination of the specimen.

From the histological appearances of the material which was curetted many difficulties presented themselves when it was attempted to make a definite diagnosis as to malignancy and to indicate a prognosis or determine an operative procedure. A uterus may harbor a malignant tumor of this type and yet the curettings reveal nothing definite. One may not encounter the tumor or may remove only small fragments of necrotic tissue that are not characteristic. On the other hand one may get definitely characteristic tissue which will lead to the diagnosis. From the curetted material of a case whose clinical history is at all suspicious a positive diagnosis can be made if one finds masses of syncytial cells and plaques of Langhans cells showing marked variations in size, shape, and chromatin content. Other histological signs of activity such as an increased number of mitoses in these Langhans cells will help confirm the opinion. In addition other facts can be found to substantiate the diagnosis. The arrangement of the syncytium and Langhans plaques shows no orderly or definite grouping, there is no relationship to chorionic villi, there is often marked hæmorrhagic infiltration, thrombi, large blood sinuses, and leucocytic invasion of the necrotic tissue which is present. Such a picture leaves but little

doubt as to the diagnosis and if in addition a small fragment of myometrium has been obtained and shows marked invasion by both cell types such confirmation allows no other opinion but chorio-epithelioma.

Unfortunately all the material submitted is not so definitely characteristic. We may get curettings that show the typical villi of a hydatid mole and a moderate proliferation of one or even both cell layers (Fig. 7). Here there is very little to base a diagnosis on and in such instances the advice of the pathologist must be to wait. If the proliferation of the cell layers is marked, mitosis active, and cell variation extreme, here again it would be advisable to operate radically rather than risk the possibility of overlooking the malignancy.

The difficulties in setting indications are numerous and there are unquestioned instances where cases have recovered without hysterectomy in which the pathologist would have been compelled to make a positive diagnosis of malignancy. On the other hand there are instances where an apparently harmless mole after a lapse of a few months or sometimes longer has reappeared as a malignant tumor. In one instance in our series a curettage diagnosed hydatid returned 2 years later with a typical chorio-epithelioma (Fig. 8). On studying the early curettings more carefully several suspicious areas were found but hardly enough to justify the diagnosis at that time. On the other hand several hydatid moles with quite similar pictures have made perfect recoveries, and remained well after periods of from 2 months to 6 years (Fig. 9).

It is just in the borderline case that the decision for the surgeon is so important and the diagnosis for the pathologist so difficult. The curettings may show no variations from the normal findings in a postpartum or postabortive case. Occasionally we have mucosa or tissue presenting only a marked increase in the syncytial cells with penetration into the muscularis (if one is fortunate enough to get a fragment of musculature in the curettings). In such an instance we are confronted with a normal picture after pregnancy, for such conditions occur frequently. In fact Hitschmann has described such appearances following labor where there is an absence of decidua and a marked infiltration of the musculature with syncytial cells often giving rise to an adherent placenta but not to a new-growth. Again we may be dealing with tissue derived from the edge of a true chorio-epithelioma, and have no other characteristic tissue from which to make the diagnosis. On the other hand the tumor may be an atypical chorio-epithelioma the course of which is often benign but in some rare instances may be malignant.

SYNCYTIAL HYPERPLASIA

This is the group of cases that Ewing has termed syncytial endometritis, and their course is extremely interesting. A study of the literature has demonstrated that this type of cases runs in almost all instances a benign course and in view of this it would seem that such individuals can safely be watched after the initial curettage and only for subsequent clinical indications as profuse hæmorrhage or infection need be operated upon.

As to the classification of their type, I do not believe that the term syncytial endometritis is a good one as the condition is not an inflammatory one and not an endometrial involvement. The inflammatory reaction that is found associated with this condition is also found in cases of true chorio-epithelioma or other intra-uterine tumors. The invasion of the uterine wall is much more extensive than that of the endometrium and the cells that characterize the tumor have no relationship to the mucosa of the uterus. As to the terminology, if one regards it as a new-growth, the original term of Marchand, atypical chorio-epithelioma, is well adapted. But is it truly a new-growth? Is it not rather an exaggeration of a normal reaction to pregnancy? These cases may form localized tumefactions but they do not truly run the clinical course of a malignant neoplasm. They do not form metastases and the lesion itself is seldom progressive as is a real new-growth, but on the contrary is benign and retrogressive in its course.

Careful consideration of the process leads us to believe that it is really not a neoplasm in the true sense of the word. Thus, if one makes the diagnosis of the condition, in view

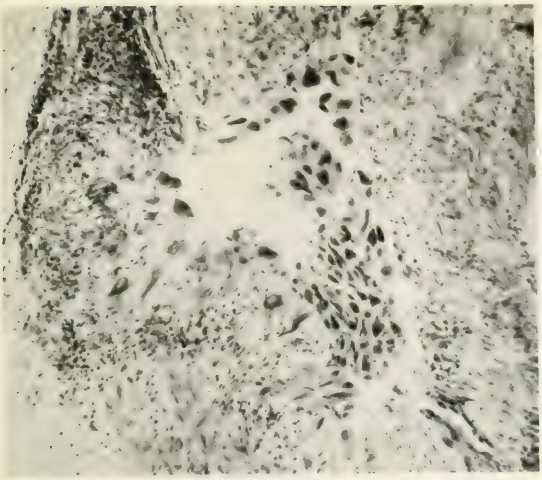

Fig. 1. Vessel filled by tumor cells and showing cells breaking through walls. Illustrates the mechanism of metastases.

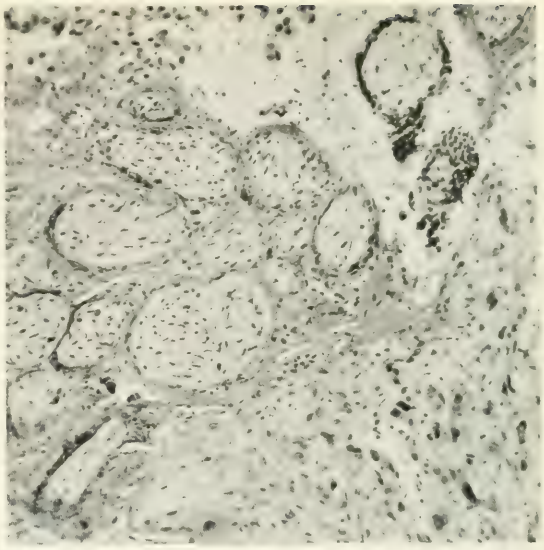

Fig. 2. Intact villi in midst of syncytial tissue invading uterine musculature.

of the benignancy in properly treated cases, it is wiser to advise waiting before any drastic steps are taken. It is from this type of case that so many reports of cures of chorio-epithelioma after curettage have been obtained, and this should be the only treatment except when complicating hæmorrhage or infection clearly indicate other procedures. Often the clinical course, especially a recurrent profuse hæmorrhage after a diagnosis of this type, will throw doubt on the accuracy of the pathological diagnosis. In such instances it would be unwise to delay operation, for even should the extirpated uterus show no true typical chorio-epithelioma, it is better to sacrifice a uterus than jeopardize a life. The designation for this condition is difficult to give, the process is not a true tumor, nor an inflammation. It represents really an exaggeration of a normal process and it would seem that a name not implying either new-growth or inflammation would be more accurate. Such a term as syncytial hyperplasia, to my mind, would be more accurate (Fig. 10). This would not apply to the group termed by Ewing, syncytioma, where a definite tumor of a definite type of cells exists.

SYNCYTIOMA

Syncytioma exists as a definite tumor and is made up of groups and islands of syncytial cells, often giant-cell in type, forming the smaller part of the tumor, the greater part being made up of blood clot, degenerating and necrotic tissue, fibrin and leucocytes, the function of which is phagocytic. As mentioned above, this process is regressive in character and the dangers from its existence are hæmorrhage due to the erosive process of the viable syncytium and its accompanying symptoms of anæmia, or infection due to curettage, which may lead to peritonitis or general systemic invasion.

This class of chorio-epithelioma is a real neoplasm and Ewing's nomenclature in this instance I believe is quite accurate and descriptive. This group represents a transition from the syncytial hyperplasia on the one hand to the advanced typical chorio-epithelioma or choriocarcinoma of Ewing on the other. It is the first real step in the nature of a true neoplasm. Ewing views it more as a regressive type of the choriocarcinoma, but it seems to me that this type of tumor composed of masses and groups of syncytium really represents a definite type of new-growth. It is not simply a regressive and degenerating chorio-epithelioma in which all the Langhans elements have disapprared, but a growth composed of one definite cell type. Its

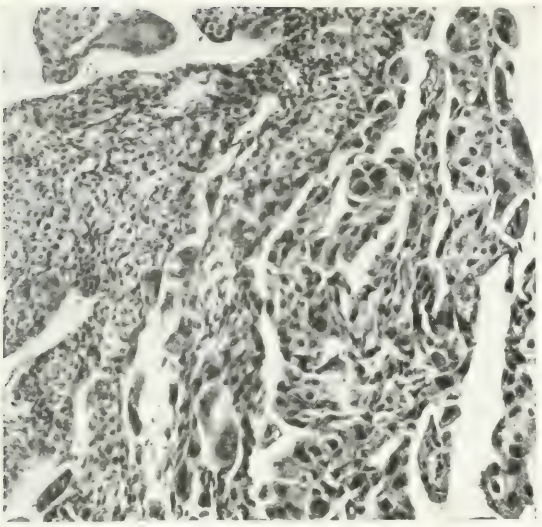

Fig. 3. Typical choriocarcinoma. Intra-uterine tumor following normal pregnancy. Both types of cells clearly shown.

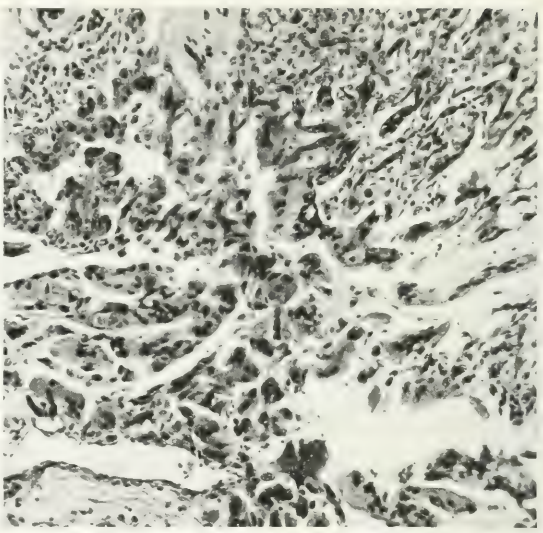

Fig. 4. Ectopic choriocarcinoma. No lesion in the uterus. Tumor localized to right pelvic wall and involving iliac vessels. Both types of cells in tumor.

histology resembles that of the syncytial hyperplasia except that the process itself is a definite tumor or group of tumors situated on and extending into the uterine wall (Fig. 11). Chorionic villi are often seen but I do not believe these to be part of the tumor *per se* but simply included groups of villi derived from the placental tissue that antedated the tumor. To my mind, they represent the starting point for this tumor. Its course is very much like that of the benign syncytial hyperplasia, and while it may cause clinical symptoms due to the penetrating and erosive qualities of the syncytium it is not essentially malignant. In this group of cases, as in the syncytial hyperplasia, if an absolute diagnosis can be made, one should wait for clinical symptoms, but if a doubt exists, he should operate. In two instances where curettings were examined, a diagnosis of "tissue suggesting chorio-epithelioma" was made. On the basis of this report hysterectomy was performed and while no true chorio-epithelioma was found, a tumor composed of groups and masses of syncytium situated on, and invading the muscularis surrounding and penetrating the vessels, was present, and we felt warranted in operating. It is true that this type of growth is rarely malignant and that many of the reported cures after curettage or incomplete operation deal with this class of cases, still, in view of the difficulty of absolutely diagnosticating the type of growth, it is better to err on the safe side and remove what may prove to be a life threatening process.

Metastases rarely take place and if they do they do not continue an independent existence but represent merely a mechanical embolic process. These cells may for a time persist but eventually become regressive and disappear.

CHORIOCARCINOMA

In Ewing's classification a group of cases is separated out and called chorio-adenoma. While such a nomenclature would be valuable it seems that many difficulties present themselves that make such a subdivision impractical. At what point in the tumor process shall one cease to say syncytioma and term the group chorio-adenoma? At the first appearance of Langhans cells? And wherein do chorio-adenoma and chorio-epithelioma really vary? The group is one of the transitional stages between the benign syncytioma and the malignant chorio-epithelioma and is better classed with the choriocarcinoma.

At times one may find a tumor that presents histologically a picture resembling

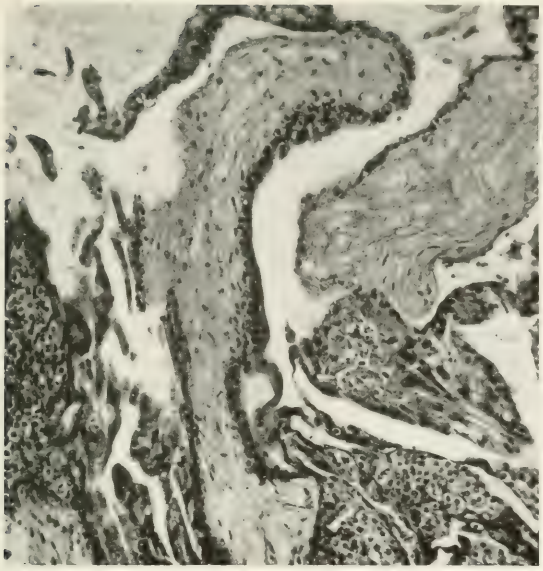

Fig. 5. Typical choriocarcinoma showing well preserved villi. See Figure 9.

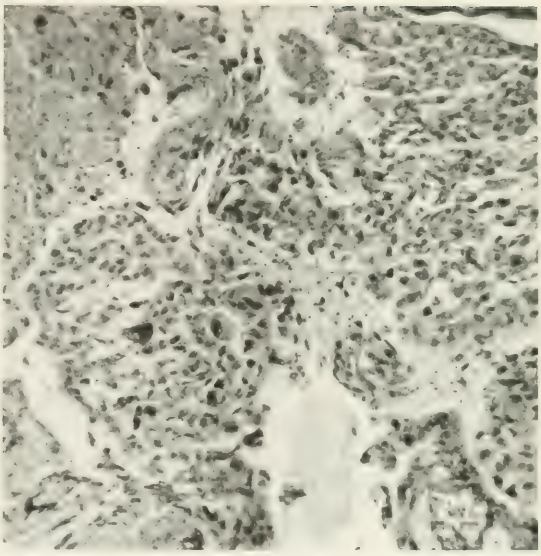

Fig. 6. Curettings showing marked proliferation of both cell types. Returned 2 years later with typical choriocarcinoma.

choriocarcinoma but with less marked cellular variations, few Langhans cells, and the presence of villi, well preserved. While this picture coincides with the group that Ewing terms chorio-adenoma it often presents areas that are indistinguishable from the true choriocarcinoma. The main argument advanced for the subdivision is the fact that these cases run a more benign course, but here again while it may be that in many instances a favorable prognosis can be attempted from a histological picture, one is often mistaken. Even the cases of truly malignant choriocarcinoma, when associated with metastases may regress after an incomplete operation, or even after none. We feel that there is nothing characteristic about the histological picture found in choriocarcinoma or its transition that would warrant a definite prognostic value until the group of syncytioma is reached. Here we feel one may prognosticate a favorable outcome with reservations and careful observations, dealing more with the clinical aspects of the condition than the histological.

The two classes just described offer great difficulties in their diagnosis from the examination of curetted or expelled material. If it is possible in these cases, in which at the time of operation the diagnosis is in question, to introduce a finger into the uterus either through the dilated cervix or through an approach operatively made (a vaginal hysterotomy), this procedure might be of great assistance, as in the malignant cases an excavation or tumor (Vineberg) can often be felt, or from a suspicious area more material may be obtained. The diagnosis of the more malignant type when clear-cut determines the prognosis and operative indications definitely. However, it is found that curettings which warrant a diagnosis of the more malignant type may be obtained from cases that, with no subsequent operative interference, do perfectly well and recover completely. Transitional types further add to the difficulties of definite classification, for there is marked overlapping of groups, and it is impossible to say when one group ends and another begins. One may have a syncytioma, then here and there a few areas suggesting true choriocarcinoma and a gradual increase in the malignant process until the picture is that of a typical choriocarcinoma. While such transitional cases may regress or may be cured by minor local interference, we feel they must be viewed as malignant and necessitate a

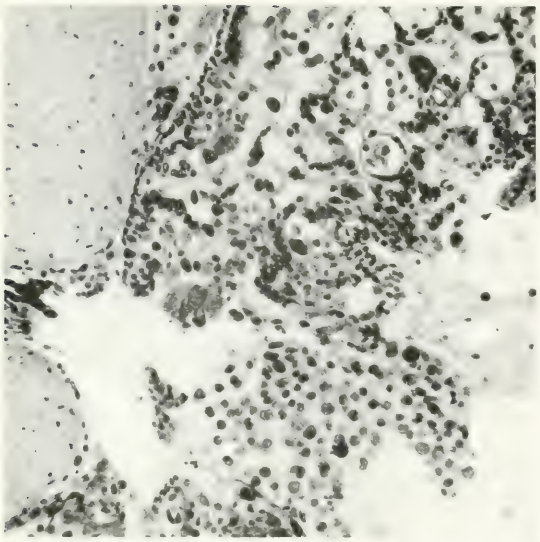

Fig. 7. Curettings showing hydatid mole with areas of Langhans and syncytial proliferation. Returned subsequently with typical choriocarcinoma in 2 months.

hysterectomy. The spontaneous regression or cures after minor operations usually occur in the cases showing few Langhans cells, or, in other words, in the group most clearly associated with the true syncytioma.

The typical chorio-epithelioma is the fully developed malignant type. Its histology is distinct and has been accurately described. Ewing reserves for this group the term choriocarcinoma, a name we feel well adapted to describe the origin and to carry the implication of its malignancy. The clinical course of this type may vary markedly from a most rapidly growing and metastasizing tumor to one that may spontaneously regress after curettage or spontaneous expulsion of tumor masses even after metastases have developed. One of the striking characteristics of this entire group of tumors, syncytioma, transitional chorio-epithelioma, and the typical choriocarcinoma is the regressive tendency so often exhibited both by the primary growth as well as its metastases, with, or even without operative removal, complete or incomplete, of the primary focus.

Of the cases under our observation all but two had a hysterectomy. Three died, one an ectopic choriocarcinoma which showed no uterine tumor but a typical growth involving the pelvic wall and broad ligament. This case died of hæmorrhage while on the operating table. The second case was one not operated upon. At autopsy this case showed a large typical tumor of the uterus and multiple metastases in practically all the viscera and skin. The metastases showed the typical structure of the primary tumor with plaques of Langhans cells and groups and masses of well preserved syncytium. The third case was one that after a curettage and packing developed a sepsis. A hysterectomy done shortly after the curettage showed a typical tumor but the patient succumbed to the general infection. (Reported by Dr. Vineberg.)

One case after a curettage, in which the diagnosis of chorio-epithelioma was made, had no subsequent operation but nevertheless made a perfect recovery. In spite of this favorable result and notwithstanding the reports of similar cases in the literature when the histological picture of material examined is that of the typical choriocarcinoma, hysterectomy, even if signs of metastases are present, is the absolute indication.

In such cases an abdominal hysterectomy and not a vaginal one should be done, for it has been shown by Hitschmann and Cristofolletti that the trauma incident to a vaginal hysterectomy often causes widespread metastases and may then influence a fatal outcome. They have also shown that cases not operated upon metastasize late while cases operated upon even after a curettage may metastasize very early and intensively. They believe that the mechanical handling of the uterus causes the emboli, and they urge the tying of the veins before the uterus is manipulated at all. They set the limit of operability by the possibility of operative removal of the primary growth irrespective of the number and distribution of metastases, as these have been known to undergo necrosis and absorption after operative removal of the primary tumor.

Schlagenhaufer, Marchand, Aschoff, Hitschmann, and Cristofolletti advocate the position that histologically there is no evidence sufficiently definite to warrant absolute prognostic value. Horman has shown that cases presenting all the histological features of malignancy such as invasion of musculature by

Fig. 8. Typical choriocarcinoma 2 years after curettage for hydatid. See Figure 6.

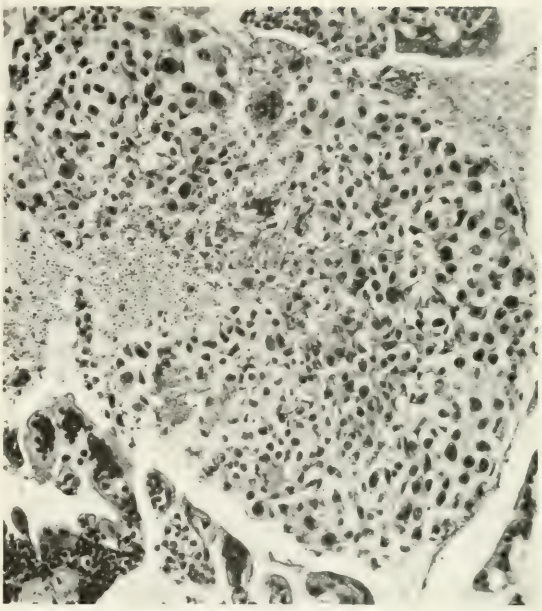

Fig. 9. Curettings showing hydatid mole and marked proliferation of both cell layers. Benign subsequent course. Illustrates difficulties of diagnosis and prognosis.

large cell masses, mitoses in fair numbers in the Langhans cells, leucocytic reaction, necrosis, thrombosis, and invasion of the vessels may have a perfectly benign course. On the other hand cases that histologically were more benign, showing absence of mitoses, villi, and signs of degeneration have gone on to a fatal issue. In my own series 3 cases diagnosed hydatid mole with proliferation of both cell types subsequently returned, one 2 months, the other 11 months later, with typical chorio-epithelioma; a third case returned 2 years later with atypical chorio-epithelioma. True, re-examination of the curettings, after the radical operation had made the diagnosis certain, disclosed microscopic fields that gave the impression of a possible malignancy, but nevertheless the picture was not sufficiently characteristic to warrant that diagnosis absolutely.

The histological study of our cases failed to show any definite relationship between the type of chorio-epithelioma and the preceding pregnancy. A normal or pathological pregnancy can give rise either to a typical or to an atypical chorio-epithelioma. It was noted, however, that the majority of the choriocarcinomata were antedated by an abnormal pregnancy, namely, a hydatidiform mole. The recorded statistics of many authors show that the majority of choriocarcinomata (50 per cent) follow a hydatidiform mole, while the remaining 50 per cent have, in about equal proportion, either a miscarriage with no abnormality in the placenta, or a normal pregnancy as its antecedent.

In the examination of various hydatid moles, histological pictures were found resembling malignancy, and yet these cases did well with no further treatment (Fig. 9). In isolated areas we may find more or less numerous appearances that to the best of our judgment cannot be differentiated from true choriocarcinoma and the subsequent course shows that these cases were benign. Naturally the complete eradication by the curette must be considered, but it must be conceded that the *individual cell power and the resistance of the host are conditions that the microscopical study of material cannot discern.*

We see the wide variations in the histology and we must accept the possibility of wide variations, not in the clinical course, for that in each group is strikingly similar, but in the prognosis. With this difficulty in prognosis goes the corresponding difficulty of setting proper therapeutic indication. Of course, in

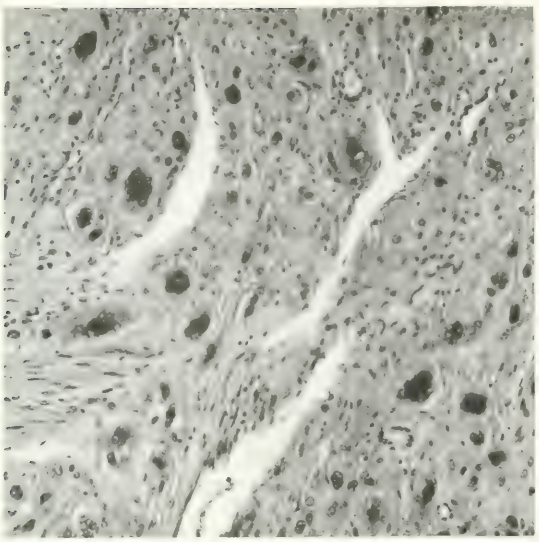

Fig. 10. Invasion of uterus by syncytial cells. Syncytial hyperplasia. No real tumor.

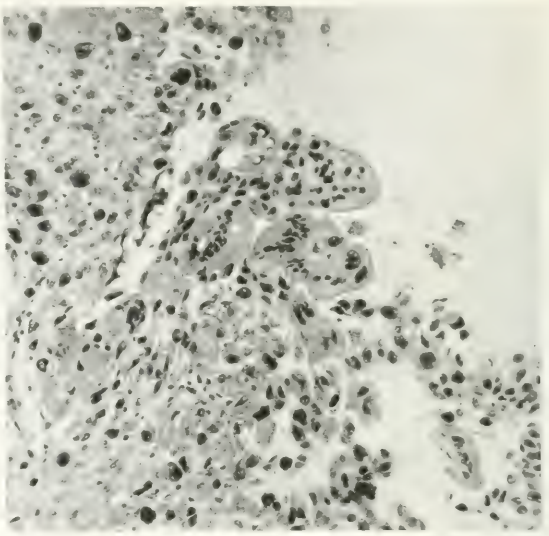

Fig. 11. Syncytioma. Mononuclear and multinuclear syncytial masses forming a definite uterine tumor.

those cases where a finger introduced into the uterus can feel an excavated tumor or where the histological evidence is clearly malignant, the indication is definite, but in those with a suspicious history and curettings that cannot be absolutely classed as choriocarcinoma, what is to be done? We feel that in view of the uncertainty of the prognosis with curettings of suspicious nature a hysterectomy is best suited to the case, for while an occasional uterus may be sacrificed more than an occasional life will be saved. True, it has been advocated to watch such patients closely and, with a recurrence of symptoms, to operate. While in many instances such advice is good, nevertheless the delay, especially after a curettage, may increase the risk by permitting such a tumor to grow or metastasize.

SUMMARY

1. There are two groups of tumors arising from the chorionic epithelium included under the term chorio-epithelioma: (a) the typical chorio-epithelioma better termed *choriocarcinoma*; (b) the atypical chorio-epithelioma better termed *syncytioma*.

2. There are numerous transition stages between these two groups.

3. A class really not a tumor, but a condition representing an exaggerated reaction to pregnancy, has been grouped under atypical chorio-epithelioma. For this class the term *syncytial hyperplasia* is suggested.

4. The diagnosis from curetted or expelled material is extremely difficult except in the clear-cut cases of the two groups.

5. Prognostic significance deduced from the histological structure is doubtful in the transitional types.

6. Indication for operation is set by a positive diagnosis of choriocarcinoma.

7. Indication to wait is determined by a positive diagnosis of syncytioma.

8. In cases of syncytioma, hysterectomy is indicated only by the clinical course.

9. In transitional cases hysterectomy is indicated.

10. Abdominal hysterectomy is the operation of choice.

11. Abdominal hysterectomy, if done early, gives fair prognosis in choriocarcinoma.

12. Abdominal hysterectomy gives excellent prognosis in syncytioma.

I wish to thank Dr. F. S. Mandlebaum, pathologist to the hospital, for the use of the material, the excellent photomicrographs, and his kind encouragement. I am also indebted to Dr. J. Brettauer and Dr. H. Vineberg for the use of the clinical data. The important literature on this subject has been ably compiled by Ewing, Surg., Gynec. & Obst., 1910, x, 366–392.

PRIMARY OVARIAN AND PRIMARY ABDOMINAL PREGNANCY—THEIR MORPHOLOGICAL POSSIBILITY

Report of a Case of Each[1]

By HENRY M. RAY, M.D., Pittsburgh
Pathologist, South Side Hospital

ALTHOUGH the possibility of primary ovarian pregnancy is now universally admitted, there are still a number of critics who have not abandoned their skepticism. Up to the present time there have been reported at least twenty authentic cases whose primary ovarian origin has been conclusively demonstrated by careful microscopical study.

The literature of ovarian pregnancy takes us as far back as 1614 when the possibility of its occurrence was first suggested by Mercer and St. Meurice. No definite demonstrable histological evidence was, however, forthcoming, and with the accumulation of data concerning tubal pregnancy in its various modifications, it became doubtful whether the early cases were not really primarily tubal. The possibility of ovarian pregnancy was strenuously denied by Bland Sutton, Lawson Tait, and Webster although it was generally admitted by most of the German writers. In 1899, however, Catherine Van Tussenbroek published a careful histological description of an early case in which she demonstrated beyond question that the ovum could be imbedded in the ovary. Three years later, Thompson demonstrated a perfectly conclusive specimen.

There are those who deny the possibility of extra-uterine gestation other than ectopic pregnancy on the basis of the process of embedding of the ovum, contending that implantation is possible only in the loose subendometrial connective tissues and in the loose submucous connective tissues of the fallopian tubes and cannot occur in the dense stroma of the ovary or on the surface of the peritoneum. Some who grant the possibility of primary implantation in the last two situations, claim that the newly implanted fertilized ovum cannot develop much beyond the stage of a most primitive chorionic vesicle, in view of the extremely vascular bed requisite for the successful development of the ovum; others who consider that a decidua vera is essential to implantation contend that the epithelial layer of the follicle internal to the lutein cells offers a morphological antagonism to the development of a decidua.

The details of the process of embedding in the substance of the ovary are not fully known nor completely understood. The desideratum is a still earlier chorionic vesicle implanted in the gland than any thus far described.

Tussenbroek considered her case proved that the essence of ovarian pregnancy was implantation of the ovum in a graafian follicle, a conclusion which has not been borne out by recent cases. Teacher and Bryce's specimen shows definitely that embedding may occur outside the lutein follicle and in this respect their specimen is especially valuable in view of the fact that the stage of development reached by their chorionic vesicle was earlier than in any of the cases recorded even to the present day.

On the basis of the description of implantation and development of the earliest authentic human ova in the literature, namely, those of Peters, Leopold, Graf Von Spe, Teacher, Bryce, and others, the process as it occurs in the normal uterine site is sufficient to justify primary implantation in the ovary and certainly on the peritoneum. The very earliest phase of the process is best seen in the lower mammals such as the hedgehog, the mouse, and the guinea-pig, which, like the human, have not only a decidua capsularis and a discoid placenta but there are also marked resemblances in respect to the gross characters of human placentation; hence, these provide a competent analogy. From a combined study of these and of the earliest human ova, we may consider that the ovum reaches the uterus as a small blastocyst still enclosed in the

[1]From the Gynecological Service of Bellevue Hospital, New York City, William Studdiford, M.D., director; and The Pathological Laboratories Douglas Symmers, M.D., director

zona pellucida. The idea that the ovum becomes embedded in a utricular gland is no longer held by any one. The endometrium presents a perfectly smooth surface free from crypts or furrows with the exception of the mouths of the glands which are too minute in the undilated state to admit an ovum. The blastocyst, about 2 millimeters in diameter (approximately the size of a mature oocyte), comes to rest in a slight depression neither a crypt nor a fissure in the endometrium and contrary to the view of invagination of the endometrium, the ectoblast by a process of digestion or solution rather than by direct erosion or phagocytosis, probably in the nature of enzyme action, actively attacks the endometrium which is destroyed, leaving a gap through which the ovum enters. A continuation of the destructive activity on the mucosa and underlying connective tissues, leads to necrosis followed by solution (digestion) of a considerable mass of the endometrium, resulting in the formation of an implantation cavity. The mouth of the implantation cavity is plugged with blood clot, the cavity in the meantime having been filled with blood shed from the opened up maternal capillaries. We still are not able to say definitely whether the formation of a decidua is essential to implantation and certainly we have no evidence that decidual formation does occur prior to embedding. Indeed, from what occurs in the hedgehog, guinea-pig, and mouse, we may infer from analogy that the human ovum may embed itself in practically unaltered endometrium and this according to most embryologists is what occurs in the human. Changes leading to the production of decidua begin immediately after the solution of the endometrium and the elevation is formed corresponding to the areas of thickening described at the site of embedding of all the early human ova.

The ovum now rapidly differentiating, develops a thick trophoblast all around the blastocyst, and the most peripheral solid portions constitute the "trophoblastic shell." The trophoblast designates that portion of the fœtal ectoderm which does not share in the upbuilding of the embryo but only in the attachment and nourishing of the ovum. Very early, the trophoblast shows a cellular layer and a plasmodial layer. The ovum, at first free in the implantation cavity, becomes fixed first by outgrowing buds of plasmodium and later by the development of primitive chorionic villi. The plasmodial buds exert a destructive action which enlarges the implantation cavity, incidentally opening up the blood vessels and setting free blood which at first nourishes the ovum and later circulates among the trophoblastic processes. These considerations together with ovarian pregnancy exclude the theory that the uterine epithelium can have any part in the formation of the plasmodium and the idea of interlocking of fœtal and maternal tissues with derivation of the plasmodial layer of the trophoblast from maternal endothelium.

Let us digress for a moment to bring attention to an error frequently made by pathologists in reporting the histological findings in tubes, the seat of gestation, where a gross diagnosis of pregnancy is impossible, due to extensive destruction of the products of gestation and a portion of the tubal wall. They describe numerous chorionic villi infiltrating the tubal musculature together with multiple islands of "decidual cells." Decidual formation is purely of maternal origin arising definitely from the maternal connective tissues. The decidual islands are erroneously named since they are really cells from the trophoblastic shell, the processes of ectoblast which attach the ovum to the walls of the implantation cavity. Indeed, in any case of pregnancy, intra-uterine and extra-uterine, it has been definitely demonstrated that practically all the connective-tissue cells of the pelvic and abdominal regions and sometimes also of the thoracic cavity undergo a change in which the cells become swollen and clear so that the appearance approaches that of decidua. The author has observed this change in the appendix removed from a woman who had a tubal pregnancy. It can be observed in practically 95 per cent of all tubes removed for ectopic pregnancy and is most marked in the cells of the walls of the vessels of the tube. In our case of ovarian pregnancy, the walls of the vessels of the tube show the decidual change very strikingly in spite of the absolute

absence of any gross or histological evidence of gestation in the tube.

In all of the recorded cases of ovarian pregnancy, there is no formation in the ovary of a decidua. In this matter the early uterine ovum sheds light on the facts of ovarian pregnancy. We have pointed out the stage in the process of embedding in which destructive changes exceed or better, precede constructive decidual changes. The formation of a decidua in the immediate neighborhood of the ovum is not essential to its embedding. The blastocyst implants itself in connective tissue which is best capable of reacting to the stimulus of an irritant or foreign body. In the uterus, tube and ovary alike the reaction is manifested first by enlargement of the vessels, followed soon in the case of the uterus by extensive decidua formation. In the ovary, the actively destructive changes persist to a later stage. These facts indicate that decidua formation is a provision of conservative nature, by which during the early months the activities of the trophoblast are limited and controlled until such time as placentation is complete.

From the analysis of all the previous cases and our own specimen, it is apparent that considerable variety occurs in the embedding of the blastocyst in the ovary, more especially in respect to its relations to the corpus luteum. Upon one point all observers are agreed, *viz.*, that the layer next to the fœtal tissue is connective tissue in some form and that the lutein cells do not play the part of decidua; certainly, they appear to play no part histologically in the attachment of the ovum. The tissue in which the ovum is embedded and subsequently becomes attached, represents the young connective tissue which is formed within the lutein tissue or theca interna in the first stage of organization of the contents of the ruptured follicle.

From application of these data, it will be seen that there are two possible situations in which an ovum impregnated within the graafian follicle may become embedded.

Embedding commences while the ovum is still a very minute object, little if any larger than the mature unfertilized ovum. Such a minute body readily finds a nidus in the thin layer of young connective tissue within the follicle.

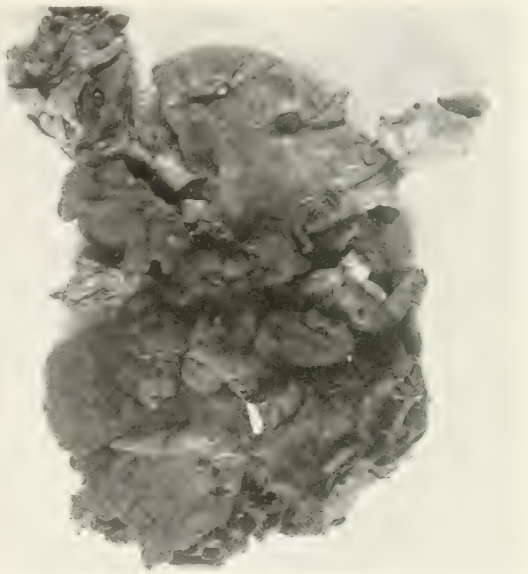

Fig. 1. Case 1, C. O. Photograph showing intact tube with orange-sized hæmorrhagic mass replacing the ovary. The deficiencies in tube correspond to area from which portions were removed for section.

On the other hand it is generally admitted that the primary and essential factor in determining the effective implantation of the ovum is a rich blood supply. In this event, the conditions just external to the layer of lutein tissue are still more favorable, and accordingly it appears that the ovum burrows out of the follicle into this layer. This accounts for the thin layer of connective tissue which separates the villi from the lutein cells in our case and in practically all previous cases in which the relation to the corpus luteum has been histologically demonstrated. As the process continues, the destructive process causes a gradual disappearance of the lutein tissue so that in the final issue, the initial evidence for the site of implantation disappears and hence we have on record the report of cases of primary implantation in the substance of the ovary (Hewetson and Jordon-Lloyd) a morphologic impossibility.

In short, the factors of ovarian pregnancy appear to be fertilization and retention of the ovum within the graafian follicle, or in its immediate neighborhood, until such time

Fig. 2. Case 1. C. O. Drawing showing corpus luteum, ovarian stroma, and organizing blood clot with infiltrating chorionic villi and fœtal trophoblast.

as it becomes capable of embedding itself by its own activities, when it may do so in any patch of connective tissue sufficiently large to accommodate it and sufficiently vascular to meet the demands of its nutrition.

Both cases discussed below occurred in Bellevue Hospital, New York, in the service of William Studdiford, whose permission I have to use the clinical record.

C. O., age 38, married, was admitted June 26, 1918, to the gynecological service of Bellevue Hospital with the complaint that 3 days before admission, she was suddenly seized with an intense knifelike pain in the lower abdomen. She fell to the floor in a faint. A similar attack recurred one night before admission. The pain radiated to the perineum and rectum and there was straining and pain on defæcation and burning on urination. There was no discharge of blood or other material from the vagina. The family and previous histories were negative. She had been married 2 years, had no children, but one miscarriage in the fourth month; menstruation began at 14, lasted over 3 or 4 days, occurred at irregular intervals and was always accompanied by dysmenorrhœa. Last menstrual period occurred May 4 and there had been no bleeding since.

Physical examination revealed a systolic murmur at the apex and some tenderness over both iliac fossæ, particularly on the left. There was no rigidity. The bimanual examination under ether showed a large soft boggy mass on the left side. Laparotomy showed the uterus to be normal in size and displaced to the right; the right tube and ovary were normal; the left tube was slightly œdematous but otherwise completely intact; milking brought no fluid from the fimbriated extremity. The ovary was replaced by a large, globular, hæmorrhagic mass enclosed in a thin capsule which was broken in several places allowing the protrusion of blood clots. The abdominal cavity was distended with fluid and clotted blood. The macroscopic diagnosis of "ovarian cyst with torsion of the pedicle" was made and hence the specimen was not photographed until the true nature of the condition was revealed in the laboratory. The patient made an uneventful recovery.

Pathological Report. Macroscopical examination. Specimen as received in the laboratory consisted of tube and ovary with large amount of blood fluid and clotted. The tube measured 12 centimeters long and the peritoneum was slightly congested. Fimbriated extremity was patent and showed no naked-eye changes; milking of the tube toward the fimbriæ brought no fluid of any kind. A fine probe passed through the fimbriated opening was obstructed at the junction of the inner and outer two-thirds; cross section here revealed no lumen to the naked eye.

The ovary was replaced by a large orange-sized hæmorrhagic mass which was irregularly broken in several places with the protrusion of blood clots through the deficiencies. The mass occupied the position of the ovary, and spread over one-fourth of its circumference was a pale grayish, slightly elevated area of irregular thickness corresponding apparently to the cortex of the ovary. The entire mass was made up of an acutely injected and granulated material, for the most part blood clot, throughout which there were irregularly scattered numerous small, pale yellowish, coarsely granular bits of tissue, suggesting in places, disintegrated corpus luteum.

Microscopical examination (40 sections examined). Sections from hæmorrhagic mass revealed everywhere, numerous chorionic villi embedded in the stroma of the ovary. There were a number of scattered giant masses corresponding to syncytium and large islands of swollen, richly chromatic cells identical with the cells of the trophoblast. Several of the sections revealed portions of the wall of the corpus luteum separated from numerous perfectly typical and well preserved villi by a thin layer of

blood clot, connective tissue of the gland, and some stroma. A portion of the blood clot showed some newly formed blood-vessels and fibroblasts. The connective-tissue lamella applied to the strands of trophoblast were necrotic, while still further away there was an evident inflammatory reaction characterized by dilatation of the blood vessels and large collections of polynuclear leucocytes and small lymphocytes. At a still deeper plane, normal connective tissue was reached. Nothing resembling a true decidua as it occurs in the uterus was seen, but the peculiar decidual change in the connective-tissue cells of the gland and more particularly in the walls of the blood vessels was very marked.

Sections from the tube revealed slight congestion and œdema of the subperitoneal connective tissue; the outer two-thirds of the tube was otherwise unchanged. The inner third showed marked involution with practical obliteration of the lumen, *i.e.*, a chronic obliterating salpingitis.

Spiegelberg in 1878 formulated certain criteria which he held must be fulfilled in order to justify a diagnosis of ovarian pregnancy. He demanded (1) that the tube on the affected side be intact; (2) that the fœtal sac occupy the position of the ovary; (3) that it be connected with the uterus by the ovarian ligament; and (4) that definite ovarian tissue be found in its wall. Our case not only meets all of these requirements but in addition establishes the relation of the process to the corpus luteum.

A. K., age 24, single, was admitted December 13, 1918, to the gynecological service of Bellevue Hospital with the statement that on the night previous to admission, she was suddenly seized with severe cramp-like pains in the lower abdomen. The severity of the pains increased progressively and she fainted twice on the morning of admission. The family and previous histories were negative. Menstruation began at 12 and was always regular, occurring every 24 days, lasting 3 to 4 days, and always with some dysmenorrhœa. On admission there was a bloody vaginal discharge which the patient said was her usual menstrual period. The preceding period occurred December 8, 1918, and was apparently a normal one. She denied emphatically the possibility of pregnancy.

Physical examination showed a young white female acutely ill and extremely pale. The abdomen was distended, tense, and showed a fluid wave. There was generalized abdominal tenderness with the maximum point of tenderness in the mid-line just above the symphysis.

Examination under ether showed the uterus in front and a soft boggy mass in each fornix. Dilatation and curettage brought forth a small amount of apparently normal endometrium. Laparotomy

Fig. 3. Case 2. A. K. Drawing showing implantation of chorionic villi and syncytial cells on peritoneal aspect of uterus and underlying myometrium. Note the acute inflammatory reaction manifesting itself by diffuse and perivascular small round cell and eosoniphilic infiltrations.

revealed a peritoneal cavity distended with fluid and clotted blood. Uterus and adnexa were delivered and both tubes and ovaries found to be absolutely normal. On the anterior wall of the uterus, just above the level of the internal os and slightly to the right of the mid-line, was a large pea-sized ragged area oozing blood from the center. At the time of operation an attempt to pass a sharp probe through the center into the uterus met with no success and the small pathological site was regarded as a new-growth. The supposed growth was excised, the gap closed by interrupted sutures and the raw surface covered by a fold of bladder peritoneum. The patient made an uneventful recovery.

Pathological report. Macroscopical examination. The specimen as received in the laboratory consisted of a small irregular piece of tissue 12 millimeters long by 7 millimeters wide. It consisted for the most part of a rather firm, yellowish gray tissue which showed on the peritoneal surface an area of hæmorrhagic infiltration extending downward for a depth of 3.5 millimeters.

Microscopical examination (8 sections examined) of tissue internal to the hæmorrhage revealed muscle bundles with the usual arrangement of myometrium. Approaching the peritoneum, the muscle fibers became looser and the vessels engorged showing dense perivascular round-celled infiltrations. Here

also, the peculiar decidual change affecting the connective-tissue cells and particularly the cells in the walls of the vessels, was very striking. More peripherally there were irregular areas of hæmorrhage throughout which were numerous collections of polynuclear leucocytes and small round cells; at the extreme periphery and actually implanted in the myometrium were numerous typical, wellpreserved chorionic villi. Adjacent to the villi were several groups of large, richly chromatic trophoblastic cells.

Interpretation of pathological findings: In concluding, primary abdominal pregnancy three possibilities had to be eliminated:

1. Abortion with perforation of the uterus and protrusion of placental tissue. The patient emphatically denied instrumentation or even that she was aware of being pregnant. The external os was perfectly virginal and free from any evidence of instrumentation. Furthermore, it would be a mechanical difficulty if not an impossibility to perforate the uterus with a sound in the region which was the site of the pathological process.

2. A perforating chorio-epithelioma. Curettage produced normal endometrium; the uterus was practically normal in size; the myometrium toward the uterine mucosa was free from chorionic villi and the patient made an uneventful recovery.

3. Tubal abortion with secondary implantation on the peritoneum of the anterior uterine wall. The tube was absolutely free from any evidence of pregnancy gross or microscopic. The inner third of the tube was involuted and the lumen obliterated; the outer two-thirds were histologically normal. The fimbriated extremity was patent, the fimbriæ unchanged and the tube in its entirety was free from adhesions.

I wish to make grateful acknowledgments to Dr. Thyng, professor of embryology, Bellevue Medical College, for assistance in obtaining some of the earlier references; to Dr. Douglas Symmers and Dr. Charles Norris, of New York, and Dr. S. Haythorn and Dr. Oscar Klotz, of Pittsburgh, for their kindness in reviewing the cases and the pathological findings.

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REPAIR OF PARTIAL AND COMPLETE LACERATIONS OF THE PERINEUM

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FOR twenty-five years I have made use of the operation herein described. Under the title "Intrapelvic and Infravaginal Perineorrhaphy without Loss of Tissue," I described the technique, briefly in 1897 (1) and in 1901 in more detail and with illustrations (2). Inasmuch as at this time and again in 1914 I cited the contributions to the literature on the subject by the meritorious contributors who preceded me (3), I will omit this phase now and discuss only the practical and important features.

The profession is pretty well agreed that all former standard operations for the treatment of lacerations of the perineum were merely vaginal resections of variable depth and extent, without restoration or improvement of the real weight-bearing structures beneath them. Mistaken conceptions of the anatomy of the female perineum have caused errors in the technique of operation for lacerations of it, and it is with the hope of clarifying these mistaken conceptions that I describe my findings. That a renuion of the bilateral backward-extending portions of the levator ani muscle and its fasciæ near the median line between the rectum and the vagina is the chief desideratum, is generally admitted and striven for; but about the exact location and the accessibility of the levator ani muscle, there is still much difference of opinion; and, frequently, more superficial structures are mistaken for it. Because the levator ani lies, normally, in a bilaterally receded position within the pelvis, behind the narrower introitus, it will not of itself, in any dissection, come out toward the median line into plain view within the lumen of the wound. It will appear so only after it has been drawn to the median line and is held there. Therefore, all who represent it as lying there naturally or voluntarily, are mistaking other structures for it—probably the narrower and firmer urogenital diaphragm, the trigone, or triangular ligament that will thus appear in the wound or dissection.

The puborectal and pubococcygeal portions of the levator ani in its fasciæ, the parts in which we are interested, can be felt plainly with a finger in the vagina of a nulliparous woman, when it is passed with moderate pressure over its lateral walls. Close under the symphysis pubis these levator parts lie, indeed, quite near or upon the trigone, triangular ligament; but they extend downward and *backward* from there, so that, when they reach the level of the rectum, they are 5 to 6 centimeters inward from the plane of the hymen; and not merely "half an inch or less," as is stated by Sturmdorf (4) and by Jellett (5), and as is inferred from the operative technique of a number of other authors. And it is closely upon the rectum that the union of the levator parts must be made, to construct a bridge 5 to 6 centimeters wide, directly over the bowel, to hold it down properly, and not merely to form a bar across the introitus internally. Operating at a depth less than 5 to 6 centimeters inward from the hymen, can, therefore, not usually fulfill the correct anatomical requirements.

Fig. 1. A drawing of a manikin constructed after illustrations by Gray and Liepmann. A cross section of the ischiorectal fossa (*a*) and of the levator ani muscle with its fasciæ (*b*), is represented. The internal pudic artery (*d*) guarded by the obturator fascia (*c*) lies upon the outer side of the ischiorectal fossa at a safe distance.

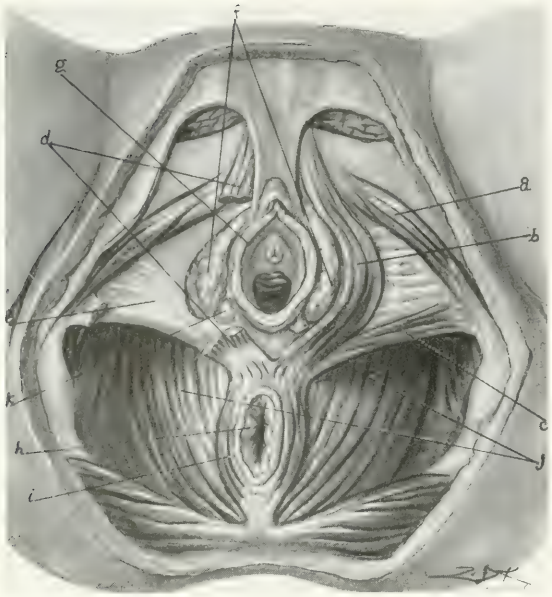

Fig. 2. Labia, skin, subcutaneous fat, superficial perineal fascia, and contents of the ischiorectal fossæ are removed. The ischiocavernosus (*a*), bulbocavernosus (*b*), and superficial transversus perinei muscles (*c*), (belonging to the superficial stratum) are intact on the left side; but the latter two muscles (*d*) are cut away on the right side to expose the urogenital diaphragm (*e*) (the middle stratum) on that side. The bulbi (*f*), Bartholin gland (*k*), vulva (*g*), and the anus (*h*) with the external sphincter (*i*), are intact. The levator ani muscle (*j*) constituting the innermost stratum is divested of its outer fascia. (From Edward Martin's *Atlas*, Plate XII.)

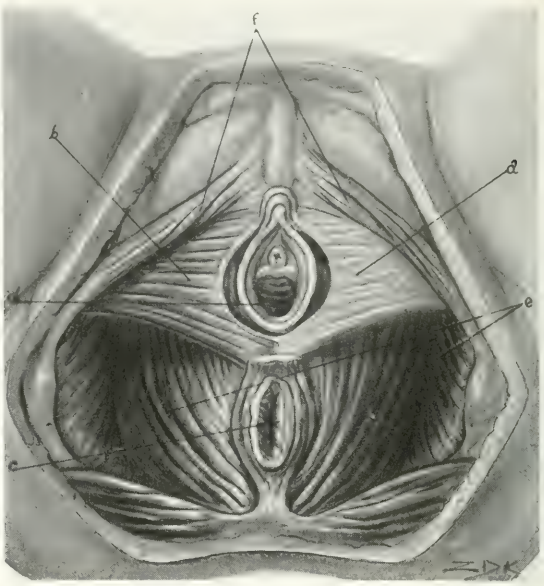

Fig. 3. The chief muscles of the outer stratum and the bulbi have been removed. The urogenital trigone, septum, or triangular ligament (the middle stratum) composed of two layers of fascia with the deep transversus perinei muscles between them, is intact on the right side (*a*), but its outer aponeurotic layer has been removed on the left side to show the fibers of the transversus perinei profundus muscle (*b*) within. The anus (*c*), the vulva (*d*), and the levator ani (*e*) are intact as before. The crura of the clitoris (*f*) are shown, the left one in its relation to the ischiocavernosus muscle. (From Edward Martin's *Atlas*, Plate XIII.)

The anatomy of the female perineum becomes clearer when grossly divided into three strata, as is done by several French and German anatomists: The first embraces the subcutaneous tissues and superficial muscles, the bulbocavernosus, ischiocavernosus, and superficial transversus perinei. The second layer is called by several anatomists the urogenital diaphragm, or trigone. By others it is erroneously called the triangular ligament, a name that suggests nothing of its composite structure consisting of two layers of fascia with a muscle, transversus perinei profundus, between them. This dense, strong, and more inelastic formation fills in the angle formed by the descending pubic and ascending ischial rami, back to the anterior border of the anus. It closely surrounds the vaginal introitus near the hymen and forms a firmer and narrower boundary around that passage than the levator ani does. Its inner borders are more easily exposed and made to stand out plainly. The *third* layer is made up of the levator ani muscle, which is lined on its upper or visceral side by the rectovesical fascia and covered by the ischiorectal or anal fascia on its under or outer surface. It is as important to engage these fasciæ for service as to engage the muscle itself; for here as well as elsewhere in the abdominal parieties, constant tension would tire out the muscle if it were not backed up by fascia to give it periods of rest.

The anatomy is fairly exhibited by the accompanying drawings, which are exact representations of most careful and authentic dissections of specially prepared female pelves, and which were made by Edward Martin (6) under the supervision of Waldeyer. They are corroborated by the special anatomical studies of these parts by Tandler and Halban(7),

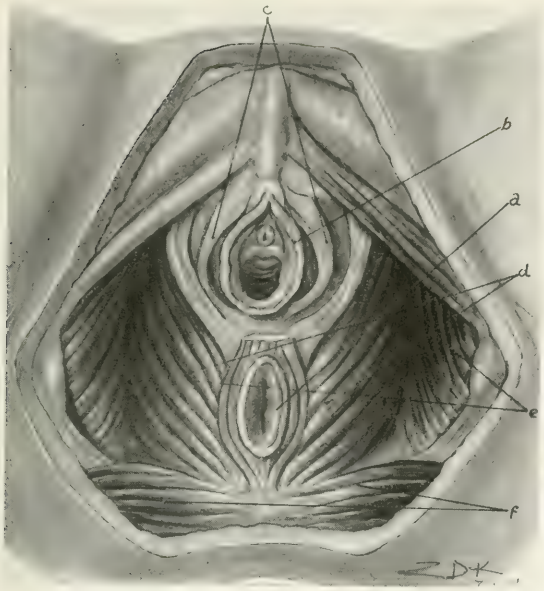

Fig. 4. All the structures of the superficial and middle strata have been removed up to the margins of the rectum (*a*) and vagina (*b*) that have been carefully preserved, the latter as a projecting collar, which is surrounded by the remaining edge of the fascial trigone (*c*). The ischiorectal fossæ have been cleared out and the muscles in their walls —the levator ani (*d*), the internal obturators (*e*), and the pyriformi (*f*) have been divested of their fascial coverings. (From Edward Martin's *Atlas*, Plate XIV.)

Fig. 5. Dissection showing the three main strata of structures in the female pelvic floor, and the three layers of the urogenital trigone, septum, or diaphragm (middle stratum). Superficial fascia (*a*), superficial transversus perinei muscle (*b*), and sections of the bulbocavernosus and ischiocavernosus muscles (*c*), together composing the outer stratum. The outer fascia of the trigone (*d*), the inner fascia (*e*), and the deep transversus perinei muscle (*f*) between these, together constitute the fascial diaphragm. The levator ani muscle, the innermost and chief stratum (*g*). (From Edward Martin's *Atlas*, Plate XIV.)

W. Liepmann (8), and Hugo Sellheim (9). Figure 1 shows that the one considerable artery in these parts, the internal pudic, lies on the outer wall of the ischiorectal fossa, at a sufficient distance to make it safe to pick up the levator structures, down near the rectum, with a needle guided by one or more fingers of the opposite hand. Only venous bleeding occurs, which stops readily when the wound cavity is obliterated in all its parts by the buried suturing. Figure 2 shows the superficial muscles of the first stratum *a*, *b*, *c*, intact on the left side; but two of them are cut away on the right side, so as to show the outer surface of the second stratum, the urogenital diaphragm (triangular ligament), on that side. Figure 3 shows this urogenital diaphragm, the trigone, or triangular ligament. Its outer fascial layer has been removed on the right side to show the deep transversus perinei muscle, which constitutes the middle layer of this three-ply structure whose inner borders constitute the most distinct and resistant structures about the vaginal introitus. Figure 4 represents the innermost stratum, the levator ani muscle whose outer fascia has been dissected off. Figure 5 is a dissection of the median line and one side of the perineum, which shows parts of each stratum, in sections.

As to operative technique Figure 6 shows about the usual first incision at the mucoskin junction. From there the posterior vaginal wall is dissected up in a flap; bluntly, when possible; or, if necessary, with blunt-pointed scissors as shown in Figure 7. It is raised inward for a distance of 5 to 6 centimeters, or

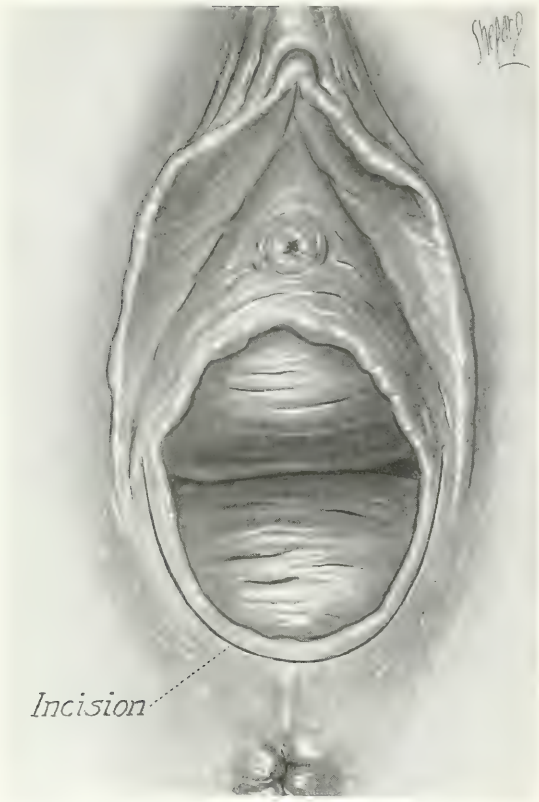

Fig. 6. Line of first incision at mucocutaneous junction.

Fig. 7. Method of raising the vaginal flap, its thickness being always noted by one or two fingers of the left hand on its upper side and opposite the points of blunt or sharp dissection, to avoid injuring the rectum. No such sharp pointed scissors should be used.

more, from the plane of the hymen to a point 1 to 2 centimeters beyond the previously located proximal border of the levator ani structures, that have sometimes receded, and on the sides to the level of the white line of the pelvic fascia, as shown in Figure 8. The

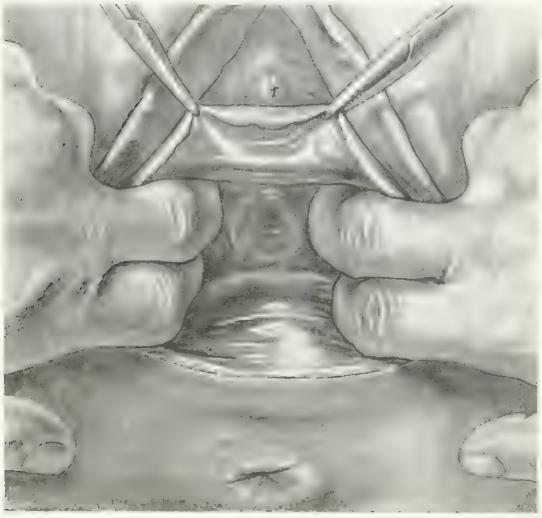

Fig. 8. The posterior vaginal wall must be raised to a distance of from 6 to 8 centimeters inward, and laterally to the level of the white line in the pelvic fascia of each side.

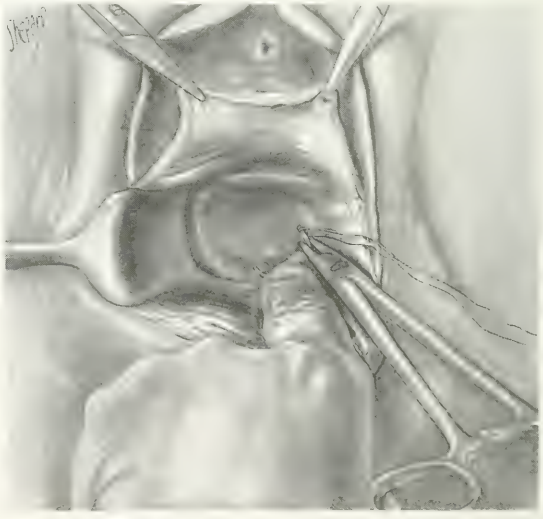

Fig. 9. The levator ani structures are seized upon each side, closely over the rectum, without sight, in a pool of blood, at a distance of 6 to 8 centimeters inward from the skin edge of the wound.

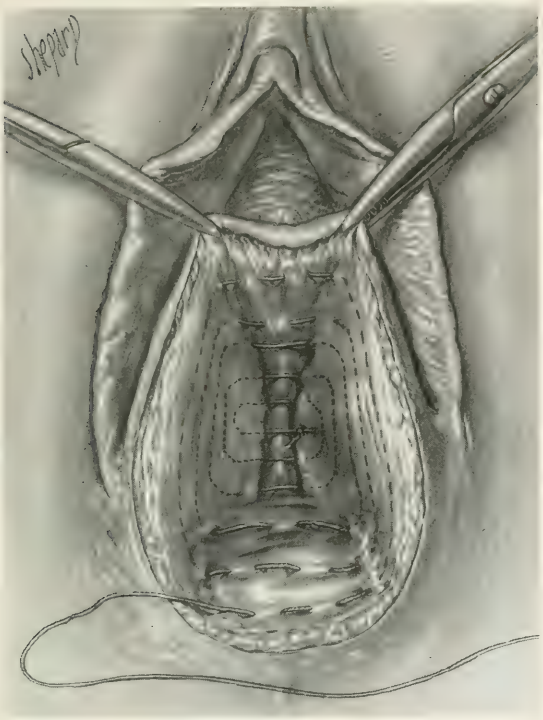

Fig. 10. After the levator has been sutured separately, the remaining wound is closed from side to side from within outward by a continous chronic catgut suture passed continuously and knotted at every second or third round. The skin wound is closed vertically by interrupted silkworm-gut sutures or subcutaneously with chromic catgut.

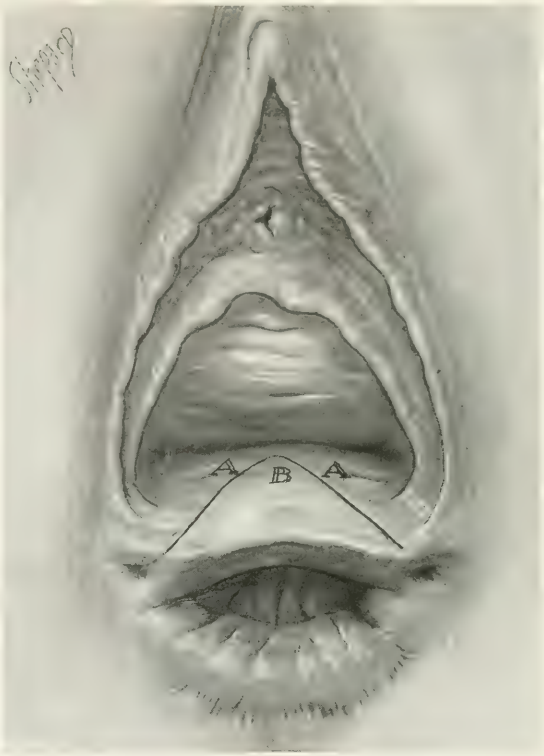

Fig. 11. Shows incision in vaginal mucosa. From its inner edge (*a-a*) a flap is raised to restore the pelvic floor; and from its outer edge (*b*), the flap is dissected outward for the plastic upon the rectum and anus.

levator muscle is traced best by its tense fasciæ between which it lies. It should not be dissected out from these, but should be picked up with them as a composite mass because the fasciæ are fully as important as the muscle which alone would be of little service. Splitting of these parts and uniting them in layers, as is illustrated by George H. Noble (10), is not advisable, because it will simply weaken them. It would take more time than all the rest of the operation; and it would be difficult to do, down upon the rectum, in a pool of blood, where the union of the bilateral parts should be made. After having been uncovered and located by touch alone, the levator structures are seized, at the side of and over the rectum, by a full curved and non-cutting needle, held in a good needle-holder, and armed with a double thread of chromic catgut. The seizure is made under the guidance of the index finger of the left hand, which holds the rectum out of the way by maintaining an intermediate position between it and the needle point, as shown in Figure 9. The serviceability of the structures seized is tested by making a pull upon them with the needle, and another grasp is made if deemed necessary. The needle is drawn through and carried directly across to the levator structures of the opposite side, which are hooked up in the same manner, under the guidance of the same finger that holds the rectum out of the way, and which stands guard here between the bowel and the needle point, as shown in Figure 9. When a satisfactory seizure has been made on this side also, the needle is drawn through and carried back to the first (left) side, and a second suture of the same kind is placed with equal care, seizing the levator structures at points a little posterior or anterior to the first one, in order to

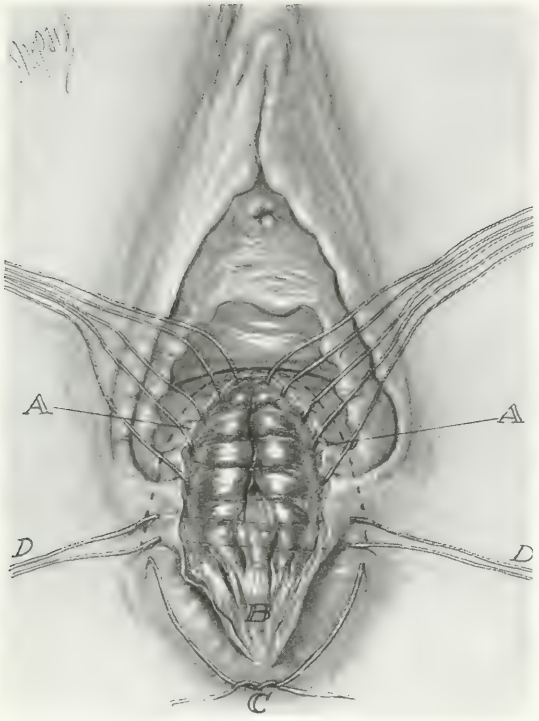

Fig. 12. Shows the outer flap (*b*), turned down over the anus. The rectal tear is closed over the everted flap, by interrupted sutures of chromic gut, that do not come in contact with the bowel mucosa; and tension upon them is avoided by the tension stitch (*c*, *d*, *d*). Sutures approximate ruptured ends of sphincter muscle.

Fig. 13. At the close of this operation for complete laceration, the tip of the everted flap will project from the anus and may be trimmed and stitched to the anal border.

secure a wider approximation. The suture is then tied, thus bringing the most important weightbearing parts into direct union with no other tissues intervening. After this, the remaining wound is closed, from within outward to the subcutaneous tissues, by the use of the same deep suture circuitously, as shown in Figure 10, with an occasional knot tied in it. In taking each of these stitches care is used to grasp a substantial piece of the lateral weight-bearing structures, notably of the trigone; this obliterates the wound cavity and stops the venous bleeding by repeatedly but gently picking up the areolar submucous tissues in the bottom of the wound, as well as on the under surface of the vaginal flap which, thereby, becomes adjusted in small ruffles as a fastened covering of the newly constructed rectovaginal septum. The vaginal flap, thus arranged in small folds and fastened to the united bearing structures beneath it produces a more massive and durable septum than could be obtained if it were cut away. Of this puckered flap a small tip only is cut away; and then an interrupted silkworm, or chromic catgut, stitch is placed which takes in the adjacent sides of the skin wound and the ruffled edge of vaginal flap, in the manner of a purse string. The remaining skin wound is closed with similar interrupted stitches, or in a subcuticular manner, as may be preferred. All the weight-bearing structures are broadly and directly approximated near the median line, which cannot be accomplished by figure-of-eight sutures ever so deeply placed, because the latter bring in non-essential tissues which interfere with direct union of the important structures; they, too, violate a general rule concerning normal anteversion

of the uterus, that the posterior vaginal wall should not be shortened.

In cases of complete laceration into the rectum, the flap or apron method described by Ristine (11) in 1899 is made use of for the rectal tear and for the external parts, in combination with the operation described for restoration of the pelvic floor. An incision through the vaginal mucosa only, in the form of an inverted letter V, is made upon the posterior vaginal wall, about 2 centimeters distant from the edges of the tear in the rectum. The ends of this incision must pass to points about 1 centimeter outside of the retracted ends of the torn sphincter ani, and a little beyond them, as shown in Figure 11. Beginning at the inner border of this incision, (*a-a*) the posterior vaginal flap is raised inward far enough to deal with the levator structures, which are traced and united; and the inner part of the wound is dealt with as described for incomplete laceration, out as far as the V incision. From the outer edge of the incision, Figure 11, *b*, the vaginal mucosa is then very carefully dissected outward, in a flap without perforation, to the edge of the tear as shown in Figure 12. After the retracted ends of the torn sphincter ani have been exposed, they are grasped with rat-tooth forceps, and the muscle is stretched moderately. Its ends are then brought together over the raw surface of the flap and united by chromic catgut re-enforced by a silkworm-gut suture. The edges of the wound above are approximated, and the cavity beneath is closed with fine chromic gut. To relieve the tension on all sutures engaged in this plastic procedure, a submucous silkworm-gut suture is passed around it within the rectovaginal septum. This is tied with moderate tension beneath the tip of the flap which, usually, projects downward within the new anus. This can be left to slough or shrink away; or it may be trimmed off if it is too massive.

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NORMAL SEPARATION OF THE PLACENTA

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UP to the present time, knowledge concerning premature separation of the placenta has been faulty, due to erroneous conceptions regarding the physiological separation of the secundines. For this reason a thorough study should be made of the process of normal separation of the placenta. The simple events during the third stage of labor have been studied by numerous investigators who have employed various methods of examination, namely, in chronological order: palpation of the abdominal wall, vaginal exploration, and X-ray examination, the last being advocated particularly by Weibel. The exact details of the physiological process have not been studied by many.

Theoretically there are three ways in which separation of the placenta might take place: first, by enlargement of the area of insertion following the evacuation of the uterus; second, by hæmorrhage between the placenta and uterus; and third, by expulsion of the foreign body as a result of uterine contractions. Franz thinks that separation must be produced by certain factors which are active during the second and third stages of labor; the diminution of the inner surface of the uterus, and the labor pains occurring at the end of the second and during the third period of labor. These two factors are emphasized in different ways by different authors. In former times the last pain of the expulsion period was believed to play an active rôle in the process of separation. More recent authors, among them Weibel, who used the X-ray in studying the third stage of labor, contradict this theory. It is now certain that immediately after the expulsion of the child the placenta is fully adherent to the uterine wall.

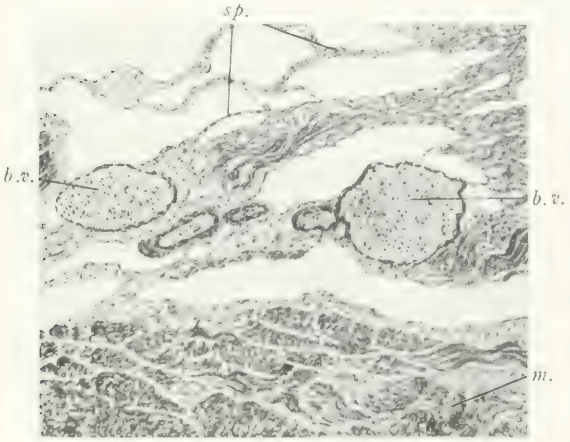


Fig. 1. Decidua serotina of a pregnant uterus at term. Placenta attached after expulsion of infant. *m.* Musculature, *sp.* trabeculæ of spongiosa, *b. v.* blood vessels.

Almost all authors lay particular stress on the importance of contractions during the third stage of labor. Among the many authors who have emphasized this point, Bumm ranks foremost and I cite his description literally. "By contractions of that part of the uterine muscle which carries the placenta, the latter is more and more removed from its area of insertion. . . . This separation is introduced by intense muscular contractions."

Special importance has been attributed by most authors to the diminution of the area of insertion of the after-birth. More recently Hohenbichler has advanced the theory that torsion of the umbilical vessels due to the sudden filling of the latter after the expulsion of the fœtus plays an important rôle in the removal of the secundines. It is obvious that this peculiar conception cannot possibly withstand scientific criticism. There are many facts which are incompatible with the idea that uterine contractions and the diminution of the area of insertion are active factors in separating the placenta from the uterine wall.

I fully agree with Weibel who believes that the placental separation is in no way coincident with the labor pains of the third stage. I have observed numerous cases in

Fig. 2. The same area, from another case. *sp. s.* spongiosa sinuses, *b. v.* blood vessels, *v. s.* vascular sinuses.

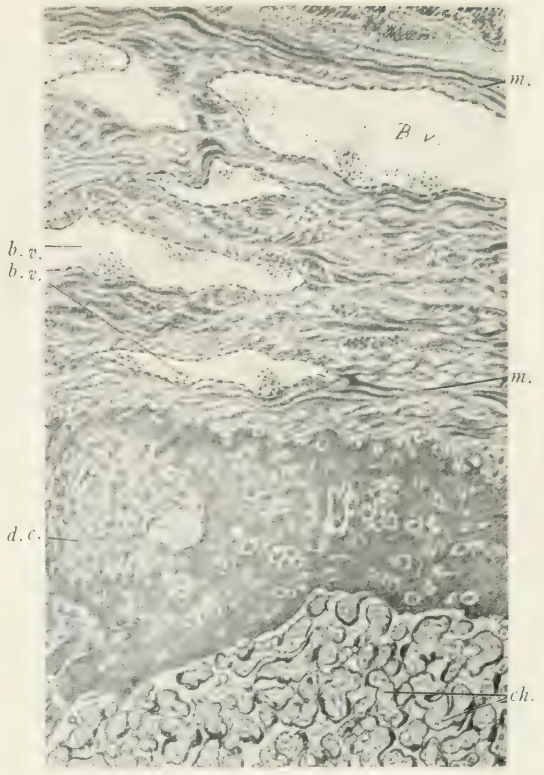


Fig. 3. The same section as Figure 1. Portion without spongiosa. *m.* Musculature, *b. v.* blood vessels, reducing the muscle bundles to thin septa, *d. c.* decidua compacta, *ch.* villi.

which palpation as well as close observation of the patient did not permit conclusions regarding the separation of the secundines. Yet, separation occurred and the placenta dropped very promptly into the lower portion of the uterovaginal tube. We have observed also two very interesting cases of cæsarean section, which showed plainly that uterine contractions occurred only after the formation of the retroplacental hæmatoma and after complete separation of the placenta.

I believe also as does Hofmeier, that the placenta possesses to a great extent the ability to adapt itself to changes in the size of its surface of insertion. Otherwise it would be difficult to understand how the placenta could withstand all the insults of intense uterine contractions during labor, unless it were a very flexible, ductile, and at the same time, compressible structure.

It is important to note that the uterine wall, in the area of insertion is very much thinner than the rest of the corpus musculature of the same level. Schroeder's atlas and Bumm's textbook show in their illustrations that the thinned portion of the uterine wall bulges almost like a hernia above the rest of the uterine surface. All authors assume that the thinner portion of the uterine wall, after expulsion of the fœtus acquires the same thickness as the remaining corpus musculature. This causes diminution of the inner surface which is followed by rupture of the trabeculæ of the decidua spongiosa. I cannot agree with the statements of these authors, because the thin uterine musculature attached to the placenta must withstand powerful contractions for a long time before the onset of the third stage of labor. Why should not separation occur during the period of expulsion, which is accompanied by intense muscular contractions? It is also improbable that intra-uterine pressure plays an important rôle in the pre-

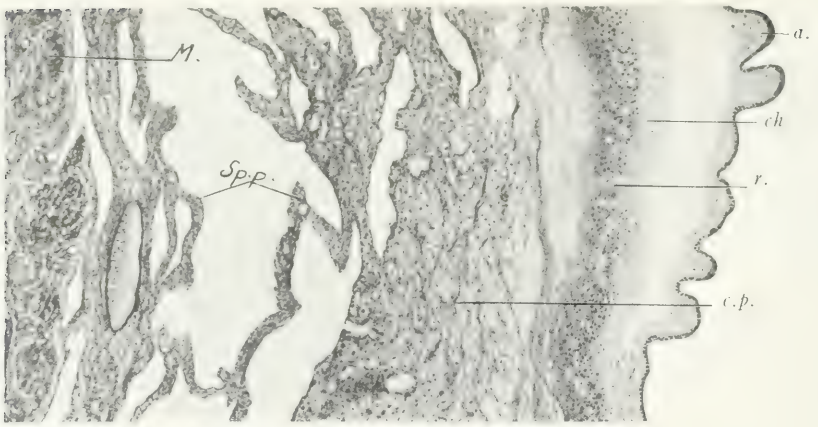


Fig. 4. Membranes *in situ*. *m*. Musculature, *sp. p*. spongiosa of the parietal decidua, *c. p*. compacta of parietal decidua, *a*, amnios membrane, *ch*. chorionic membrane, *r*. reflexa, in involution, connected with the compacta basalis by loose tissue bundles.

vention of rupture of the trabeculæ of the decidua spongiosa.

It is my opinion that the musculature attached to the placenta remains thin as long as the placenta is attached to it. Intense contractions of the uterine muscle are impossible while the placenta is attached to the inner surface of the uterus. Such contractions will occur only, after separation has been effected by other happenings. We can readily prove this by the examination of microscopical sections of uteri, to which the placenta is attached after expulsion of the fœtus has taken place. Of the two specimens, which I have in my collection, one was obtained 2 years ago from a patient who died from influenza.

We know that placental separation is effected within the decidua spongiosa. Figure 1 shows clearly that the trabeculæ of the spongiosa are extremely delicate and contain vessels greatly dilated with blood. The thin walls of the vessels protrude in most places beyond the outlines of the trabeculæ. Figure 2 shows many compacta vessels, which in the area of the spongiosa become enlarged and form branched vascular sinuses. The hyperæmia *ex vacuo*, following the expulsion of the fœtus, produces a greatly increased influx of blood into the decidua as well as into the muscularis. Rupture of the above mentioned decidua spongiosa sinuses and vessels which are deprived of any support by decidual tissue follows this intense hyperæmia. Up to this point neither contractions nor diminution of the area of adhesion plays any active rôle in placental separation and the production of the retroplacental hæmatoma. After the formation of the hæmatoma between the placenta and uterus, the musculature is capable of contraction and will become thickened to the extent of the corpus musculature of the same level. It is therefore certain that neither muscular contractions nor diminution of the area of insertion of the placenta is the cause of the separation of the after-birth, but rather the result of it.

Wherever the spongiosa is absent, one finds that numerous large blood sinuses are present in the musculature adjoining the placenta (Fig. 3). Between these sinuses are very delicate fragile muscle bundles, which play the same rôle as do the trabeculæ of the spongiosa, where the latter is present. This explains why one sometimes finds smooth musculature on the maternal surface of the expelled placenta.

The separation of the membranes is effected by traction exerted by the separated placenta, and occurs either within the trabecular portion of the spongiosa or, more frequently, within an area of certain loose fibers, lying between the compacta of the parietal decidua and the decidua reflexa (Fig. 4).

DEPARTMENT OF TECHNIQUE

PLASTIC PROCEDURES FOR THE OBLITERATION OF CAVITIES WITH NON-COLLAPSIBLE WALLS[1]

By ALLEN B. KANAVEL, M.D., F.A.C.S., Chicago

THE closure of cavities with non-collapsible walls at times presents problems of the keenest interest to surgeons. Such procedures may be a necessary adjunct to operative intervention where suppuration in a cavity cannot be controlled, as for example following osteomyelitis, empyema, or the formation of adventitious cavities by long continued infection and consequent fibrosis. They may be necessary as a part of operative procedures for cosmetic purposes, as will be illustrated later.

No claim to originality can be made when considering the technique in these cases, but it may be worth while to bring to your attention certain cases presenting somewhat unusual opportunities for such procedures. It is sometimes forgotten that cure in patients with non-collapsible cavities can be secured only by respecting well-known surgical laws of repair of tissue. The walls of cavities must come in contact with one another or with other living tissue, or must be so close together that proliferating cells from their walls can ultimately meet. In the latter instance, it is well known that there is a limit to epithelial proliferation, because of the fibrosis which takes place wherever granulation tissue is formed. Just how large a cavity can be filled by the proliferation of epithelial cells cannot be stated in definite terms, since the vascularity of the part and other factors, such as the nature of the infection and the body resistance, must always be taken into consideration. Removal of the hard, unyielding, fibrous wall will permit greater growth from the underlying structures, and greater possibility of collapse if, as in the pleural cavity and cavities developing in soft tissues, the nature of the surrounding structures permits or favors such a procedure. At times such an operation may be impossible, as will be illustrated by the following reports.

Among the problems presenting themselves have been cavities in the skull, in the long bones, in the pleural cavity, in the abdomen, and in the soft parts. Where it is possible to secure collapse of the cavity by removal of the wall, this is the procedure of choice.

If simple measures fail, or if the nature of the structure is such as to prevent collapse, the transplantation of living tissue from the same individual, either in the form of free or pedicled transplants, will often be of the greatest benefit. In my service both forms have been used with success. Where possible the pedicled transplant should be used.

The use of free transplants has in my hands been restricted to transplants of fat. I have used fat transplants a number of times in porencephalic and osteomyelitic cavities. With the former type I have had no failures so far as I know. There has been no infection or loss of the fat, and I believe that the transplants have obliterated the cavities. Several patients suffering from convulsive and pressure symptoms seemed to be relieved. No deleterious consequences have been observed, but owing to the nature of the disease from which the patients suffered it would be unwise to claim brilliant results. With osteomyelitic cavities failure has generally followed the use of free fat transplants. It has seemed to me that this is due in large part to the poor blood supply of the walls of the cavity rather than to the infection present, because in only one case was the graft lost *in toto*. In almost all cases, however, the fat exuded in droplets during the succeeding weeks so that the transplants gradually disappeared. For this reason we ceased some years ago to use this method. The transplantation of free flaps of fat might succeed better in a decorticated pleural cavity, but other procedures have always seemed preferable, so that we have not attempted it in the treatment of empyema cavities.

In the transplantation of pedicled flaps of fat and subcutaneous tissue, of muscle, or of the two combined, we have a method that has been used for years with great success by all of us.

The following cases present some factors out of the ordinary and, owing to the difficulties

[1]Read before the Chicago Surgical Society, April, 1920

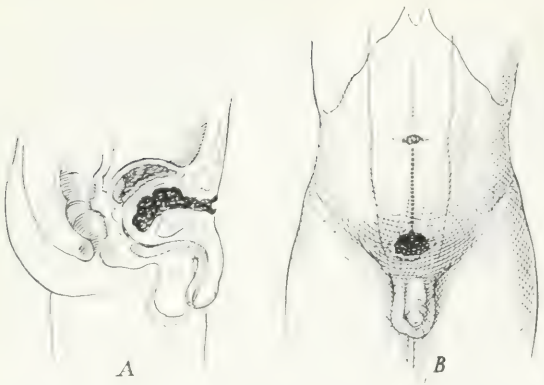


Fig. 1. Mr. E. V. Schematic drawing showing opening of sinus and position of cavity.

presented and the excellent results obtained, seem worthy of presentation.

Mr. E. V., Wesley Memorial Hospital, No. 78494.

For 5 years previous to operation this patient had an open sinus 1 inch above the symphysis pubis which was discharging more or less constantly. The discharge was purulent, and at times had a very offensive odor.

Ten years before entering the hospital, in jumping over a fence, the patient fell on the end of a rake handle, which entered the left groin and penetrated the abdomen. At the end of 3 months he had recovered from the immediate effects of the injury, but the wound in the groin was still unhealed. At the end of 9 months an abscess developed in the left gluteal region. After this abscess had been thoroughly drained the opening in the groin healed, but a new sinus developed in the gluteal region. About 6 months later the patient developed peritonitis, and was ill for 4 months. Three years later he suffered an inflammatory reaction over the entire lower part of the abdomen. He was taken to the Cook County Hospital where the old wound, which was still discharging, was excised and curetted. After operation the discharge increased for 4 or 5 weeks, following which the abscess was again opened and drained anteriorly, through a median incision 4 inches in length just above the symphysis. This wound healed in 6 weeks' time, though pus continued to discharge from the gluteal wound.

Six months later another abscess formed in the lower abdominal wall, which was opened. This continued to discharge until the patient came to us. The opening in the gluteal region had healed 2 or 3 months after his discharge from the hospital.

In addition to the symptoms mentioned, the patient suffered pain in the left leg below the knee. This was especially evident when he was on his feet.

On examination the patient showed a large ventral hernia, and a small discharging sinus close to the mid-line just above the symphysis.

At operation, April 20, 1919, there was found an abcess cavity the size of a large orange in the space of Retzius, with thick fibrous walls so intimately united with the lateral walls of the pelvis, the anterior wall of the bladder and the urethra that excision of the wall of the cavity was

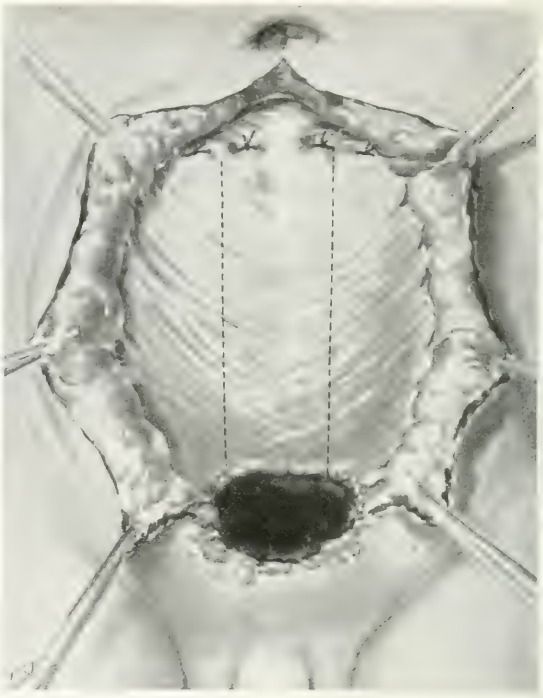


Fig. 2. Mr. E. V. Showing sinus and incision into the anterior sheath of the rectus.

deemed impossible. There was no tendency for the walls of the cavity to collapse.

An incision was made from the umbilicus to the symphysis pubis, and the orifice of the sinus was excised. The anterior sheaths of the recti were incised close to the median line, and both muscles exposed as high as the umbilicus. The recti were cut across at this point and the upper ends sutured to their sheaths so as to prevent retraction. A wide, pedicled flap of subcutaneous fat and fascia was also prepared. The walls of the cavity were curetted and the pedicled flaps of muscle and subcutaneous tissue turned in to obliterate it. The two cut edges of the sheaths of the recti were sutured in the median line; a strip of rubber glove was inserted for drainage; and the skin and fascia were closed by figure-of-eight sutures of silkworm-gut.

After operation the wound discharged for 3 weeks, during which time it was irrigated three times daily with Dakin's solution. At the end of this time the patient left the hospital with a small discharging sinus which closed completely in 3 weeks, and has not reopened. The patient has gained 30 pounds in weight and has had no trouble since. Examination 18 months after

Fig. 3. Mr. E. V. Showing sutures holding upper part of rectus with incision into the recti for pedicled flaps.

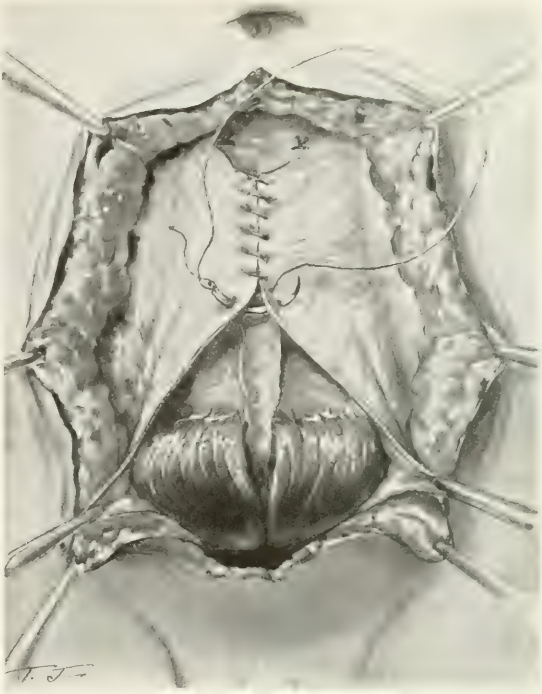


Fig. 4. Mr. E. V. Showing closure of anterior sheath of the recti after pedicled flaps had been put into cavity.

operation discloses a weak abdominal wall, with a diffuse bulging.

This patient had been operated upon by several able surgeons, and in spite of excellent surgical technique and care, the cavity was not obliterated. The intimate association of the walls of the cavity with the bladder and pelvic structures precluded the possibility of dissecting away its hard, fibrous walls and permitting it to collapse. The weakness of the abdominal wall, resulting from the operation, is in nowise comparable with the disability and distress occasioned by the constant purulent discharge and the constant absorption of retained toxins. The rapid restoration of the patient to perfect health fully justified the extensive operative procedure.

Mr. E. F., Wesley Memorial Hospital, No. 69537.

Three years ago, 2 weeks after operation for enlarged glands of the neck, this patient noticed a painless, non-inflammatory swelling of the forehead, which persisted for a years. At the end of that time the swelling broke down, leaving a deep ulcer whose base involved the frontal sinus. The ulcer healed under antisyphilitic treatment, leaving a deep unsightly excavation over the forehead.

On examination the patient showed a healed depression of the forehead about 1 by 2 inches in its lateral dimensions, and 3 inches in depth, involving the frontal sinus of the left side. There was a small bridge of skin running across the center of the area. The bone at the base of the depression was covered by granulation tissue.

At operation the edges of the skin were freshened and the bridge of skin removed. A flap of

Fig. 5. Mr. E. V. Two years after operation.

Fig. 6. Mr. E. F. Showing transplant of pedicled skin and fat healed in frontal sinus 4 weeks after operation.

hairless skin with its pedicle was outlined on the left forearm and the incision extended downward from the lower end of the flap for a distance of 2 inches, so as to permit securing an additional area of subcutaneous fat and fascia as large as the flap itself; in other words, the subcutaneous portion of the flap was twice as long and of the same width as the cutaneous portion. The forearm was carried to the forehead, and that portion of the flap consisting of fat and subcutaneous tissue doubled under the first portion so as to fill the excavation in the bone. The edges of the skin were attached to the skin of the forehead, and the arm held in position by a plaster-of-Paris bandage. In the course of the next 20 days the pedicle of the flap was partially severed at intervals of several days and finally completely detached, after which the remaining free edge was attached to the skin of the forehead.

No nasal trouble nor sinus infection followed the operation. A small edge of the skin flap sloughed, leaving a scar after healing one-fourth inch wide at one edge. The skin of the flap remained on a level with the surrounding tissues. After the excision of the small linear scar and reunion of the edges, the result will be perfect from a cosmetic standpoint.

This patient had a syphilitic osteomyelitis, with such an extensive excavation because of the depth of the frontal sinus that had skin alone been used to cover it the result would still have been most unsightly. With the double flap the defect was

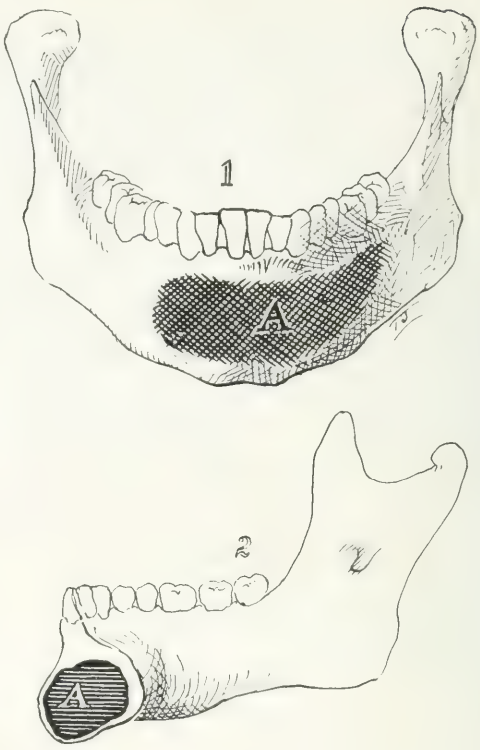


Fig. 7. Mr. A. B. Schematic drawing showing size and position of cyst in the mandible.

filled, with the result that 3 years after operation the skin was still on a level with the surrounding tissue. The small scar seen along the edge had flattened out considerably and was so little noticeable that the patient declined to have this excised and the edges of the skin brought together. Except for this, the result was perfect.

Mr. A. B., Wesley Memorial Hospital, No. 88839.

Twenty years ago this patient began to have trouble with his teeth, particularly with those on the left side of the mandible. They were extracted, one by one, until only the incisors were left on this side.

Fourteen years ago a swelling, which at first was soft and compressible, appeared on the left side of the chin; the application of pressure over the swelling produced a discharge of bloody fluid in the mouth. The swelling was lanced six times during a period of 6 months, with no result except the appearance of a bloody discharge. At the end of that time the mass, which except for one small area had gradually become indurated, was removed with apparent success.

Nineteen months ago a hard and brawny swelling reappeared and increased in size for 2 months. Thereafter it remained stationary in size, but gradually became so painful that for 2 months previous to admission the patient was unable to sleep at night. During the latter period the mass seemed to become softer in consistency. There was no history of fever or chills at any time.

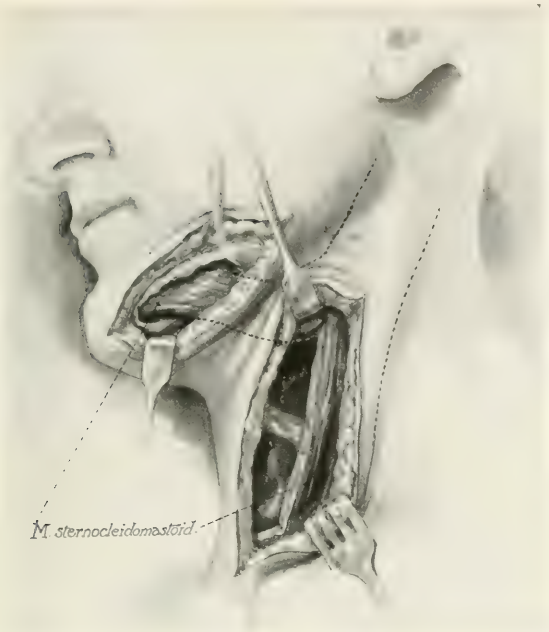


Fig. 8. Mr. A. B. Showing technique of obliteration of cavity in the left side of mandible.

There was nothing of interest in his past record except for the history of a fall on the chin at the age of 5 years. He had had no venereal infection. He had not lost weight.

The physical examination was negative, except for an assymetry of the face, due to the presence of a tumor mass which involved the left side of the mandible in its anterior half. This mass was about the size of an egg, was hard and brawny, with the exception of a small fluctuating area about the size of a hazelnut. The mass was fixed, seemed a part of the jaw, and extended into the floor of the mouth on the left side. The skin over the mass was movable and not inflamed. There was moderate tenderness present on pressure. There were no palpable submaxillary or cervical lymph glands on the left side. There was a scar, 4 centimeters long, along the ramus of the mandible on the left side. The patient's leucocyte count was 14,500. The coagulation time of the blood was 3 minutes. Urine examination showed no abnormal findings.

At operation there was found a cyst of the mandible extending from the first molar of the left side to the first bicuspid of the right side. This cyst was limited by a definite wall and was filled with glairy mucus and fibrous tissue. The posterior portion showed no bony wall externally, but the anterior portion close to the symphysis had a thin, parchment-like covering of bone anteriorly. The inner and posterior wall was formed of the corresponding thick cortical layer of the mandible. The cavity was the size of a large thumb. The symphysis had bulged forward slightly so that there was some prominence of the chin. It was evident that the inner wall was

Fig. 9. Mr. A. B. Showing obliteration of cavity on right side of mandible.

sufficiently strong to support the jaw, so that no bone transplant was necessary, but that if the anterior wall were destroyed, considerable deformity on the left and in front would result. No teeth were found in the cavity.

An incision was made under the left side of the mandible, the skin dissected upward, and the contents of the bony cavity with its lining removed. To fill the resulting cavity with living tissue a pedicled flap was prepared from the left sternocleidomastoid muscle, by using the sternal and a part of the clavicular portion, freeing it from the sternum, and swinging it upward and inward under the skin and deep fascia close to the angle of the jaw so as to insert it into the cavity in the mandible. Since the end of this

Fig. 10. Mr. A. B. Photograph taken 10 days after operation.

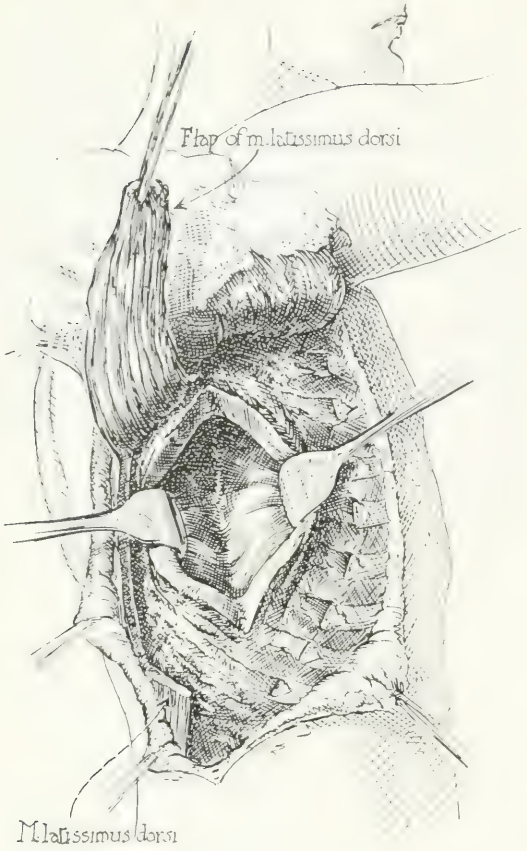


Fig. 11. Obliteration of old empyema cavity.

flap would reach only to the symphysis, a second incision was made upon the right side under the mandible, and a flap of platysma muscle with the overlying fat and fascia raised from underneath the chin and turned forward into the remaining space through an opening in the thin shell of bone which formed the anterior wall of the mandible in that position. The wound was closed without drainage.

The wounds healed by primary union, and the patient was discharged in 10 days, apparently completely recovered.

Had the anterior wall of the cavity been broken into so as to produce obliteration in this case, or had it been removed so as to permit the soft tissues to fall in and obliterate the cavity, a most unsightly deformity would have resulted. By the method used the contour of the jaw was maintained. Sufficient time has not elapsed to report on bone formation, but the operation appears to have been successful in every way.

Pedicled flaps in the pleural cavity have been used with perfect success. I have already reported the first case in which I used this. (C. B., operated upon at Cook County Hospital, No. 594895.) Since that time I have had occasion to supplement thoracotomy by pedicled flaps in several instances, and always with perfect satisfaction.

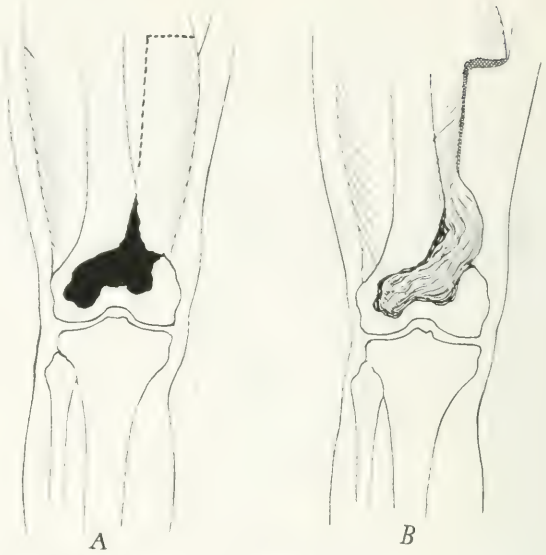


Fig. 12. Mr. R. S. Showing obliteration of cavity filling entire lower end of femur.

With old osteomyelitic cavities, it is a *sine qua non* that they should be obliterated either by removal of the walls and overhanging bone, so that the surrounding soft parts can come in contact with the bone throughout; or by a pedicled transplant of muscle, fat, or skin laid into the depth of the cavity in such a way as to produce obliteration. This I have done many times with success. These cases are usually not difficult, since they ordinarily involve the shaft of the bone. One patient, however, presented a particularly interesting problem because of the presence of a cavity in the lower end of the femur, involving practically the entire head of the bone down to the articular surface. If one had attempted to remove the walls, the joint would certainly have been destroyed. The detailed history of this case is as follows:

R. S., Wesley Memorial Hospital, No. 36862.

This patient had suffered from a discharging sinus on the inner side of the left femur at its lower end for over 2 years. Three attempts had been made to cure it. At the first operation, during the acute stage, the thigh was incised and drained. At the second operation the sinus was curetted and a sequestrum removed. At the third operation the wall of the osteomyelitic cavity was partially removed, and the operation was followed by antiseptic treatment.

When he came to us there was a large sinus on the inner aspect of the thigh, leading down into the lower end of the femur. X-ray examination showed a cavity involving the lower end of the femur, and separated by only a thin wall from the knee-joint. General examination showed nothing of importance.

At operation the cavity was opened by a longitudinal incision at the medial side of the quadriceps extensor. No dead bone was found. The cavity, which occupied the entire lower end of the femur, was curetted and its overhanging edges removed. A flap of muscle taken from the edge of the quadriceps extensor with its base downward was turned into the cavity so as to obliterate it. The skin was sutured with catgut, and a rubber tube for the instillation of antiseptic solution was inserted.

There was considerable discharge for 2 weeks after operation, and a slight discharge for 10 weeks. After three injections of bismuth paste, the wound healed completely and remained closed. The patient was discharged in 4 weeks, being cautioned to be careful in using his legs for the next year. He reported 4 years after operation that he had had no trouble, and that he had taken part in track athletics and basket ball with no injurious results.

AN ADJUSTABLE EXTENSION AND SUSPENSION "BALKAN" FRAME

By NATHANIEL ALLISON, M.D., F.A.C.S., St. Louis
Professor of Clinical Orthopedic Surgery, Washington University School of Medicine

THE appliance here described is not new in any of its principles. It represents a device used with unusual success during the war in our military hospitals. The details are clear from the illustrations. It is made of ordinary $1\frac{1}{16}$-inch tubing and can be adjusted to any type of hospital bed, 2 feet 6 inches in width and 6 feet 6 inches in length.

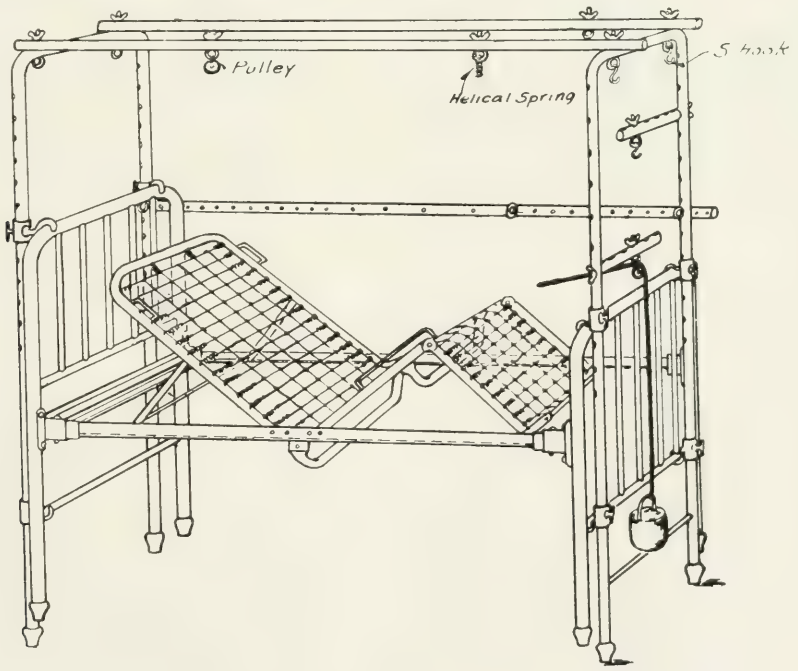


Fig. 2. Adjustable extension and suspension frame for treatment of fractures and joint injuries. Height of frame 6 feet 6 inches from floor, 2 feet 6 inches wide. Made of $1\frac{1}{16}$-inch tubing, with rubber covered adjustable malleable iron hooks and wood plugs, two long top bars, one long side bar two short foot bars drilled so that any sort of adjustment can be made.

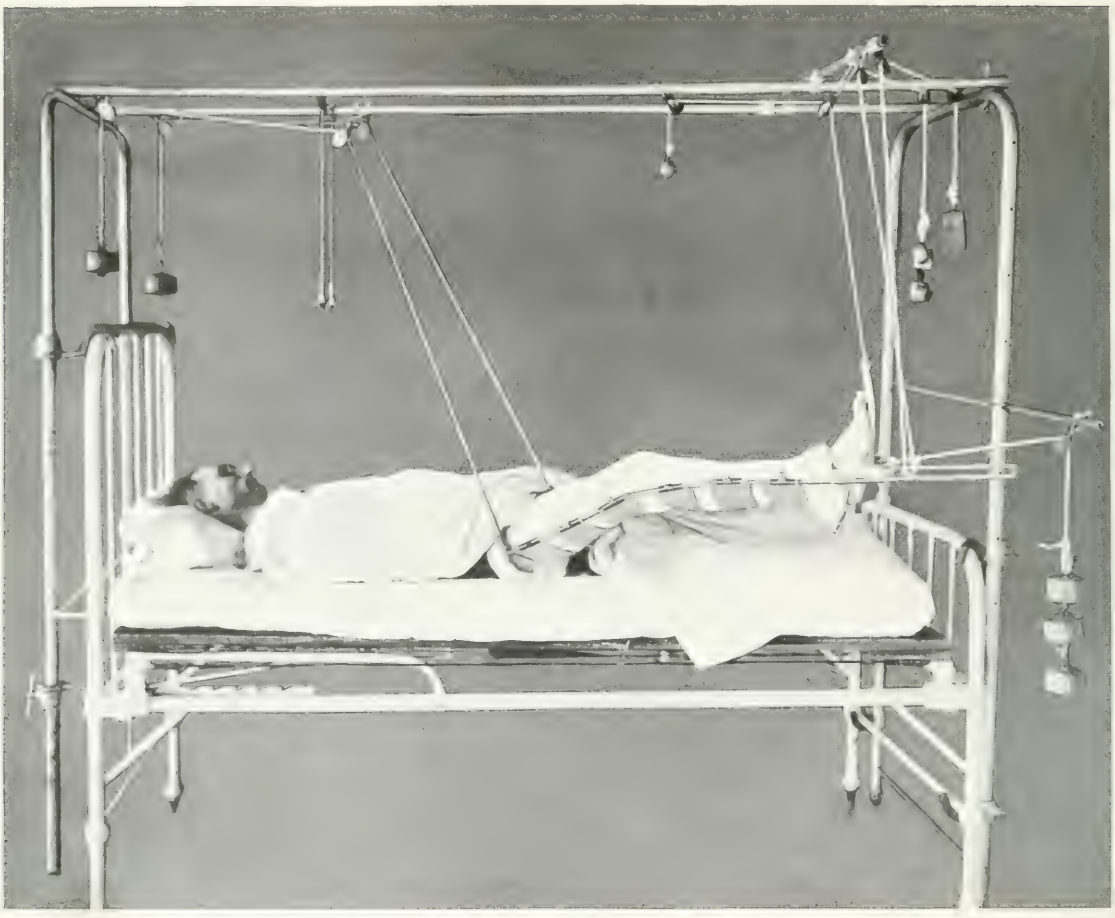


Fig. 1. Photograph showing frame in use.

It is described for the following reasons:

To emphasize the value of the suspension treatment of fractures and joint injuries in our civil hospitals;

To interest others in having available in our hospitals for immediate use a frame made of tube which will not present the disorderly appearance of the wooden Balkan frame which is used at the present time in our civil hospital wards.

The frame possesses greater rigidity than the wooden frame.

It is not expensive, and adjustment is more easily and perfectly carried out.

TREATMENT OF LONG STANDING DISLOCATIONS OF THE HIP

By J. SCHOEMAKER, M.D., The Hague, Holland

IN January, 1902, a young woman consulted me in regard to a limp which had been growing worse, more painful, and fatiguing. I had known for some time that the patient had a dislocation of the right hip. Two years ago I had operated upon her to correct a right femoral hernia.

At the age of 10, 13 years ago, the patient was extremely ill but she remembers only that at that time she had a high fever and that her illness may have been typhoid. After her recovery she limped although before this she had walked normally. The lameness grew worse and worse and she was advised to wear a thick sole on the right shoe. Even with this she did not like to walk and finally could walk a distance of but a half mile when she suffered much pain in the gluteal region. The right leg was in normal position and could be moved in all directions. The muscles were not so fully developed as on the left side. The shortening was 6 centimeters. The top of the trochanter was 6 centimeters above Nélaton's line. It follows, therefore, that the bones of this extremity were normal. A line drawn tangentially from the top of the great trochanter along the anterior superior spine of the ilium and extended up to the middle line reached the mid-line at the symphysis; on the opposite side the intersection was at the umbilicus. (This line which I have named the trochanter-spina line was described in the *Zeitschrift fuer Orthopædie und Chirurgie*, vol. xix, is very valuable in indicating displacements of the great trochanter.)

X-ray examination revealed a dorsal dislocation of the femur, the head and neck of which appeared fully developed. In the presence of these findings I could not resist attempting to reduce the dislocation. It was doubtful whether this could be accomplished for (1) the soft parts were so short difficulties might be encountered especially with the long thigh muscles; (2) the capsule might be too narrow; and (3) the acetabulum might be filled with tissue. It is a well known fact that soon after dislocation the acetabulum is often filled with fibrous tissue from the capsule and the torn ligamentum teres.

The following technique was used: First we planned to reduce the dislocation after powerful extension. If this failed we planned to expose the joint, incise the capsule, clear the acetabulum, and then try to replace the head of the femur. If this proved to be impossible, we planned to shorten the femur, but this step was to be employed only as a last resort. We proceeded as follows: The leg was held in extension by means of a 6 kilogram weight. After a fortnight the patient was anæsthetized and a Lorenz traction apparatus applied. This produced such effectual extension that the level of the trochanter was considerably owered. The traction apparatus was then loosened, the femur flexed as far as possible and, with the head of the femur attached to the pelvis, strong abduction was made to stretch the adductors very forcibly. After this the limb was extended again to repeat this extension. In other words, we used an imitation of Lorenz' method of reducing congenital dislocation of the hip. The manœuvre was crowned with success. When at last the knee was flexed and the limb lay parallel with the chest, the trochanter was directed straight downward and all the long muscles of the thigh acted in the same direction. In this way the head of the femur was pulled downward. We next abducted very strongly so that the knee was pressed flat on the table. The head of the femur thus passed to the front. Thus we brought the head of the femur in position on the pelvis in the supposed position of the acetabulum. We did not feel the jump of a reduction, but in bringing the limb toward the middle line the head slipped over a ridge with a palpable tug and flew back to the original dislocation position. The head had been placed under a bony wall, which stopped the reduction, probably the limbus of the acetabulum. This reduction manœuvre was repeated and although there was no perceptible jump a plaster-of-Paris splint was applied with the limb strongly abducted and the knee lying upon the table. Palpation showed the head of the bone below the iliac spine. We were convinced that reduction had not been accomplished but the head of the femur lay just over the acetabulum. We supposed the displaced capsule and the tissue in the acetabulum prevented reduction but hoped ultimately to bring about reduction by the continuous pressure of the head of the femur. Another chance was that the dorsal dislocation might be transformed into a pubic dislocation. The patient complained of violent pain at the inside of the knee on recovering from the anæsthetic. She indicated exactly the place which is pointed out in cases of early inflammation of the hip-joint. From this we concluded that the capsule was pressed tightly. It was not possible to secure an X-ray picture until 6 weeks later at which time the head appeared to be entirely inside the

Fig. 1. Case 2, position of the head in dislocation.

Fig. 2. Case 2, head resting on acetabulum.

Fig. 3. Case 2, head inside acetabulum.

acetabulum. The reduction had succeeded! The patient was again placed in a plaster-of-Paris cast, but the limb was not so strongly abducted as before. She could walk on it very well at this time. After 6 weeks this second plaster cast was taken off and the hip was found to be normal and the patient walked without a limp.

Case 2. A man, age 61, was knocked down by a motor car. He was brought to the hospital on December 3, 1919, nearly senseless. An immediate diagnosis was made of dislocation of the hip on both sides; on the left side an obturator dislocation and on the right side a dorsal luxation. The diagnosis was confirmed by X-rays. The dislocation of the left side was reduced by the house surgeon, Dr. Huese, without any difficulty, but it was not possible to reduce the right dislocation. The next day I examined the patient myself. The left hip was normal. On the right side the trochanter was 4 centimeters above Nélaton's line, the trochanter-spina line met the middle line 2 fingers' breadth above the symphysis, on the left side one finger's breadth above the umbilicus. The limb was rotated slightly inward and abducted a little but was not flexed. The leg could be flexed to 45 degrees and abducted about 30 degrees. In studying the X-ray plate the radiologist noticed that the acetabulum seemed a little flat, so he questioned whether it might not be a congenital dislocation. In the presence of a normal head and neck, congenital dislocation seemed doubtful; on the other hand the position was not very characteristic of a traumatic dislocation, nor was the fact that the limb could be moved without producing pain. When we asked the man, whether the hip was the same as before the accident he did not give a decided answer but said he thought it was. I did not agree with him. I tried to reduce the hip under an anæsthetic, but was unsuccessful. When the patient recovered from the anæsthetic he declared he would not be treated any further; the hip always had been just as it now was and he could walk very well. Three days later he trained himself to walk. He soon walked fairly well and after a fortnight he left the hospital. He was a little crippled but had no pain. Six weeks later I heard that the lameness had grown worse and that he soon became tired and suffered pain. His wife told me that he had never before been as he is now and that before being hurt his gait was quite normal; his foreman too answered affirmatively, whereupon I advised the man to come back to the hospital as soon as possible. He did so on February 16, 1920. He then told us that his present condition was quite different from what it had been before injury and that he attributed the condition to the accident. Meanwhile it had become a dislocation of long standing because 2 months had elapsed and according to all investigators a dislocation of the hip is considered as of long standing after 6 weeks. Notwithstanding this we left nothing undone to obtain reduction. On February 21, the man was anæsthetized and the limb flexed and abducted as in the previous case. Preliminary traction was not employed because at the present time not much faith is placed in it in the treatment of congenital dislocations. We flexed the leg continuously until we brought the knee to the chest and then we abducted as far as possible. At last we got the limb in a position at right angles to the axis of the trunk and almost to the level of the table. The whole manœuvre took about half an hour and was done without much force. We did not observe a reduction jump or click. The limb was put in plaster of Paris in this position and the patient made no definite complaints on recovering from the anæsthetic. The next day, X-ray examination showed the head of the femur resting on the acetabulum. Fifteen days later the plaster cast was taken off and abduction diminished. Clinically it was obvious that the hip was reduced and this was confirmed by the X-ray plate. Figures 1, 2, and 3 show the position of the head in dislocation, resting on the acetabulum, and inside the acetabulum, respectively.

A new plaster cast was not put on, the patient was allowed to diminish, little by little, the abducted position of the leg. After 4 days the leg lay extended and could be moved very well both actively and passively. Then he trained himself to walk and on March 24 he left the hospital, walking normally.

In these two cases we have reduced dislocations which might fairly be called long standing dislocations. A report of the first case was published in 1902 in the *Deutsche Zeitschrift fuer Chirurgie*, lxvi, but at that time I felt that it was too early to state definitely that this treatment might be looked upon as the method of choice. In 1903, Goldmann, *Deutsche Zeitschrift fuer Chirurgie*, lxvi, reached practically the same conclusion, and quoted the case I published. He reduced a perineal dislocation 84 days after injury. At the time of examination the roentgenograms showed that the head of the femur lay on the acetabulum but was not entirely inside it, due to the presence of fibrous tissue. Six weeks afterward another X-ray showed clearly that the head of the femur lay quite inside the acetabulum and there was no visible intervening space. Because the possibility of bringing the head of the bone into the acetabulum was so well proved by these two cases, Goldmann proposed that reduction should be tried in all cases of long standing dislocation. When this means of reducing the dislocation is not successful, or even partly successful, he suggests doing a transposition (as suggested by Lorenz and Codivilla). In reducing a dislocation forward, the head rests on the pubis and a nearthrosis is formed. Lorenz[1] did such a transposition in 1907 and was well satisfied with it. Notwithstanding, the method was not generally accepted, the prevailing opinion being that an operation is necessary when a dislocation cannot be reduced in the usual way. I question this: The advocates for operation, as Payr,[2] Dollinger[3] and Buchanan[4] argue that bloodless reduction is more dangerous than the operative method because the femur may be broken at the neck or shaft, muscles may be ruptured, or there may be a great deal of shock. I believe we need not reduce the dislocation so roughly as to fracture the bones or rupture the muscles. I grant that Lorenz's description sounds rather terrifying. In a man 34 years of age, an assistant had tried to reduce the dislocation but in vain and Lorenz performed a transposition. The shock was very severe and even alarming during the first and

[1] Orthop. Congress, 1908.
[2] Deutsche Ztschr. f. Chir., liv.
[3] Ergebn. d. Chir. u. Orthop., iii.
[4] Surg., Gynec. & Obst., xxxi.

second day. All possible efforts were made to overcome this. The scrotum, the thigh and the abdomen were swollen so that the plaster had to be taken off on the day after operation. The patient recovered and left the hospital with external rotation and a thick sole in his boot. A roentgenogram showed that the head of the femur was in front of the acetabulum.

It is true also that operative reduction is not accomplished without difficulty. Payr states that in a case of irreducible dorsal dislocation of the hip of 4 weeks' duration such force was used in producing extension that the head of the femur was brought to the acetabulum but it slipped off. Operative reduction was then performed. This was obviously very difficult and required the greatest effort. The man died the same evening. The postmortem examination showed bleeding into the psoas muscle and rupture of the adductors.

We should modify our technique according to conditions found. When there is an old dislocation and the roentgenogram shows normal proportion between the head and acetabulum, we may try reducing the dislocation in the usual way. As a rule this fails, and yet there is no indication for open reduction not even for a transposition. The head must be brought to the entrance of the acetabulum with the limb placed in complete abduction after complete flexion. The thigh must be at right angles to the axis of the body, on a level with the symphysis. This position can be attained only with the patient in deep narcosis. With the patient on his back, the sound limb is held fixed by an assistant. The injured leg is seized by the knee and the foot and is flexed as far as possible without much force. The knee must then be drawn outward and the limb abducted. The leg is afterward extended a little and brought back to the middle line. In this way a horizontal circle is described and the starting point is reached. This movement is repeated several times, and on each occasion a larger circle is made. With every movement of flexion the head of the femur passes downward and with every movement of abduction it comes to the front. A circle is thus made which is so large that on flexing the knee, the femur is parallel with the body and on abducting the femur it is at right angles to the axis of the body. The head of the femur then lies in front of the acetabulum and it is fixed in this position in plaster of Paris. The following day a roentgenogram is taken to show whether the head lies in correct position in front of the acetabulum and if it does the plaster is kept on for a fortnight, at which time the cast is taken off and the patient is allowed to bring the leg back into the normal position. This is accomplished slowly as the muscles have become accustomed to the abnormal position. The result is again controlled by roentgenograms and if the head of the bone is really inside the acetabulum the patient should be encouraged to walk.

I believe this method should be used in all dislocations of long standing and in irreducible dislocations of the hip. The only danger is that an anæsthetic must be used. Ruptures and fractures need not occur for all manipulation should be practiced with moderate force. If reduction is not successful at once, it may be accomplished in two stages. Success was immediate in the only two cases I have treated so it should not fail in other cases. Both were backward dislocations. In irreducible obturator or sciatic dislocation I should try in the first place to convert them into dorsal dislocations and then reduce them against the entrance of the acetabulum.

A NEW PROCEDURE IN THE TREATMENT OF ECLAMPSIA

By H. J. DAVIDSON, M.D., Seattle, Washington

I HEREIN present a new procedure in the treatment of eclampsia which I have used with gratifying results in eleven cases. In making this preliminary statement it is my earnest desire that application may be made by other observers, the better to establish its value.

Of the universally accepted procedures I have discarded excessive bed clothing and heat applications in their several varieties for the purpose of inducing perspiration, and substitute therefor the following:

The stomach tube is passed every four hours, for the purpose of leaving from a liter to a liter and a half of water in the stomach. If this simple procedure is adhered to the patient will soon begin to perspire with surprising copiousness without application of heat, and without being weighted down with excessive bed coverings.

Several questions naturally present themselves as possible objections.

The patients are usually unconscious and some object to tubing such cases. The ordinary precaution as to determining that the tube is in the stomach and not in the trachea, meets that objection. Regurgitation and aspiration, as far as my observations go, need not be feared. A remarkable flatulency and general atonic condition usually prevail. The large amount of water introduced seldom produces regurgitation. The water may be introduced fairly rapidly and the tube quickly removed if regurgitation retching intervenes. The marked flatulence and apparent atonic state of the gastro-intestinal canal might suggest acute gastric dilatation into which it would be inadvisable to introduce large quantities of liquid. My observations lead me to believe no anxiety need be felt as to that condition. That the stomach empties itself is established by the fact that in no instance have I ever recovered any portion of the water introduced four hours previously, although I have often left in well over one and a half liters.

As to the soundness of the judgment upon which this treatment is based, I submit the following suggestions:

We are dealing with a toxic kidney block, rather than a true nephritis. The amount of urine the kidneys can secrete as soon as the block is broken is truly surprising. Indeed it is limited only by the amount of ingested fluids.

It is a recognized fact that fluids introduced through the stomach are excreted by the kidneys more rapidly than if introduced into the rectum, into the tissues by hypodermoclysis, or even intravenously. I have recovered by catheterization as little as two ounces of urine for the eight-hour period at the beginning of treatment, and in the next succeeding eight-hour period, thirty-two ounces, and a total of over one hundred and twenty ounces in the first twenty-four hours of return of renal function.

Epsom salts in ounce or ounce and a half dose should be given once or twice in the 24 hours, and some alkali, as 20 grains of potassium acetate and citrate mixture, each time the tube is passed. The bowels usually move copiously without the use of more drastic catharsis.

Initial control of the convulsions by large doses of morphine hypodermatically, spinal puncture if the eye grounds indicate it, combating flatulence by means of esserin, pituitrin, hot stupes and enemata, and cardiac stimulation should not be neglected. I have not resorted to initial bleeding even in cases of extreme œdema.

The benefits as I have observed them are numerous. Gavage every four hours is far more simple than repeated hot packs, and can be done in the home where efficient hot packs are impossible. The debilitating effect of the hot pack on the heart is avoided. A far larger amount of fluid is introduced into the body than can be done by any of the customary methods. The large volume of fluid introduced probably stimulates natural peristalsis, and aids in accomplishing efficient evacuation, without necessitating resort to the drastic cathartics. And I believe the desired therapeutic result is more promptly and more efficiently achieved.

As a final admonition I would urge that in severe cases at least three gavages be performed after the patient is considered well out of the critical state, to insure against recurrence of convulsions and consequent disappointment as to the value of the procedure.

GASTRO-INTESTINAL SUTURING FORCEPS

By RAFE C. CHAFFIN, M.D., Los Angeles, California

MANY methods and devices have been used to facilitate the Connell suture in gastro-intestinal surgery. The best instrument I have seen for this use is the Judd forceps, and the accompanying cut shows a modification of that forceps by which it is given many advantages. Neither the skilled surgeon nor the occasional operator need have any special experience in using this instrument to take advantage of its many good points. Figure 1 shows the open forceps and Fig. 2 *a* and *b* illustrates the technique of its application.

Anastomosis is carried out in the usual manner until the posterior mucosal suture is completed. With the suture emerging from the serosa at the angle of the gut opening, the forceps are held in the left hand with the handle pointing toward the elbow. The single tooth is inserted under the mucosa within the lumen of the bowel close to

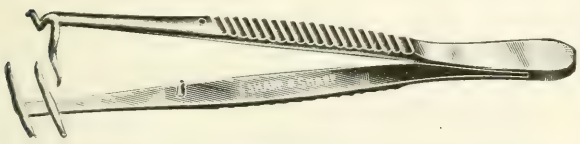


Fig. 1. Author's gastro-intestinal suturing forceps.

the point at which the last suture emerges. The forceps are closed and the single tooth elevates an area of tissue under which the needle is passed pointing toward the operator (Fig. 2*a*).

The next manœuvre is to withdraw the tooth of the forceps and by rotating the hand slightly the opposite single tooth is inserted on the opposite side (Fig. 2*b*).

This is continued, alternating with the two sides, until the opening is closed. The assistant holds the thread taut each time while the operator is inserting the needle.

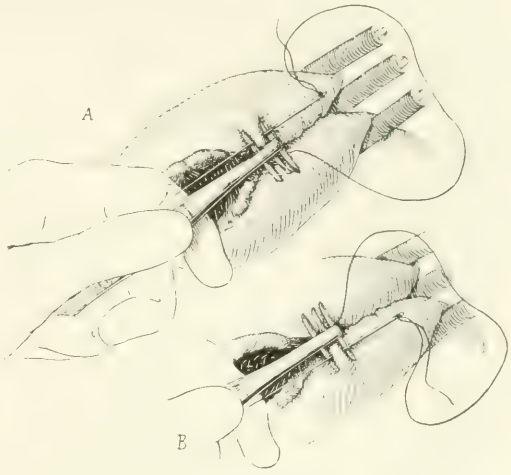


Fig. 2. *a* and *b*. Application of forceps.

ADVANTAGES

1. Accurate spacing of all stitches;
2. All stitches grasp all layers, thereby minimizing hæmorrhage;
3. Rapid closing because of minimum amount of motions necessary;
4. Least amount of soiling of field.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

PERHAPS one of the most important contributions to the field of surgery as a result of the recent war, has been the focusing of attention upon injuries of the peripheral nerves. Not common in civil life, they heretofore had passed unobserved. The work[1] under consideration is a material example of this importance. Written in an interesting and logical manner, the authors have crystallized the plethora of material on this subject into a pleasing and compact volume.

The real object of the treatment of peripheral nerve injuries is restoration of function by the most logical method of direct nerve suture. Restoration of complete function is perhaps the pinnacle of success to be reached in only a limited number of cases. Return of function of the simpler actions is a common result but the return of those finely co-ordinated movements which require years of training to develop, does not offer a particularly promising prognosis. To attain this end, however, should always be the objective and it is interesting to note the emphasis given to several points in the treatment followed by the writers. There seems no more room for doubt concerning the fact that the living primitive sheath must be present to expect recovery, which must always be a matter of months. The insistence upon a pre-operative preparatory treatment of massage for secondary deformities and atrophies is a matter of no little import. The suturing of the nerve ends does not complete the treatment. Postoperative passive and active movements and electrical treatments are continued until recovery is assured.

The differentiation between complete and incomplete anatomical lesions is a difficult one. A question arises as to whether or not any given group of signs or symptoms suffices. The marked atrophy of an incomplete ulnar lesion and the pronounced paralysis of a similar radial lesion are cases in point. The clinical course is of much more importance in making a diagnosis.

The diagnosis of regeneration and recovery used by the authors follows closely those principles laid down by Head and his co-workers. Recently, some question has been raised as to the reliability of all of those signs. It is a debatable point whether or not protopathic sensibility occurs before epicritic sensation in an area free from the influence of overlap.

The importance which the surgery of the sympathetic system is assuming is hinted at by the authors' suggestion that the causalgias resulting from an irritant incomplete lesion may depend upon injury to the sympathetic fibers carried in the main trunks along with fibers serving motion and sensation.

The chapters dealing with the operative technique emphasize the value of various resections and dislocations necessary to obtain a direct nerve suture. The use of Cargile membrane, hardened animal veins, and other materials to protect the line of suture have been discarded for the simpler protection afforded by a muscular bed.

This little volume represents one of those rare works which give us the meat of the subject in a manner which makes it a work of art. L. E. DAVIS.

IN this illustrated work[1] the author reviews the subject of fractures of the neck of the femur, including the etiology, bony architecture, and blood supply of the neck, pathological anatomy, the course of bony union, the symptoms and diagnosis, and the various common methods of treatment, both by open operation and other means. Delbet's classification of true cervical fractures (recent), cervicotrochanteric or intertrochanteric, and pseudarthroses is advanced leading up to his method of treatment for these conditions. The treatment offered was first undertaken as routine in 1914 and the present report is based on 128 cases.

Arthrotomy of the hip-joint is not employed because of the seriousness of the operation and fear of possible interference with blood supply of the femoral head. For fresh true cervical fractures he uses an American screw 7 to 9 centimeters long, driven from a point 1 centimeter below the greater trochanter of the femur through the shaft into the head. Local anæsthesia is required for metal screws, general anæsthesia for bone transplants. The incision is 5 inches long over the trochanter of the femur. The legs are completely extended, the injured leg being pulled down by mechanical traction, and the great toes tied together, with the feet straight up. The injured limb does not lie in abduction or inversion. By means of his special metal guide which is placed beneath the patient's hip and in correct relation to the head of the femur (which has been localized and marked by fluoroscopic ex-

[1] INJURIES OF THE PERIPHERAL NERVES. By Henry S. Souttar, C.B.E., F.R.C.S.(Eng.), M.Ch. (Oxon.), Major, Ex-R.A.M.C., and Edward W. Twining, M.R.C.S., L.R.C.P. (Lond.), Capt., Ex-R.A.M.C. New York: William Wood & Company. 1920.

[1] ANNALES DE LA CLINIQUE CHIRURGICALE DU PROFESSEUR PIERRE DELBET. No. 7. Fractures du Col du Fémur. By Antoine Basset. Paris: Felix Alcan, 1920.

amination, with the leg under 15 kilos of traction), the exact angle the screw must take to enter the head is fixed. It cannot go too far into the pelvis nor can it miss the head. This screw is threaded but one-half its length and although its function is transitory, it maintains co-aptation, reduces the fragments, causing pressure between them, and leads to bony union. This metal screw has been tolerated as long as 4 years. Four patients out of 31 died, 3 required secondary operation of 26 true cervical fractures so treated, in 2 the results were unknown; all others gave good functional results—one a bony union in 40 days. For cervicotrochanteric fractures the screw is not employed because bony union invariably results. Delbet's ambulatory splint is used for these patients except for very fat individuals or old females, for whom the screw is used.

For the pseudarthrosis he urges a strong bony transplant of fibula completely denuded of periosteum to open all haversian canals to revascularization. In 24 such cases there were 2 deaths. Twelve patients followed for 1 year gave promise of further improvement and in 7 cases followed from one to 6½ years the results were very satisfactory. Three cases gave excellent results. All operations were performed without arthrotomy or freshening of the bone fracture surfaces. No plaster-of-Paris casts were needed after operation. Out of 44 screw operations and 24 bone-grafts, he has had but 6 failures. In some instances his ambulatory splint apparatus is applied at the time of operation, but more often the feet are left simply tied together. Patients who have had a screw inserted, wear the apparatus 36 days; those who have had bone-grafts inserted wear the apparatus 45 to 60 days, using crutches in the meantime.

Four days after all operations passive motion and massage are started, patients are made to get up and walk as soon as possible. After fresh cervical fracture when wearing the ambulatory splint they get up in from 3 to 13 days; without the splint in from 12 to 30 days. After bone-graft operations, when wearing the ambulatory splint they are got up out of bed in from 10 to 40 days and without the splint in 2 to 60 days. They use crutches but are instructed *to walk correctly* and are made to use a cane as soon as they gain confidence.

American readers will be greatly interested in obtaining Delbet's personal technique and seeing his results, because his exactness of procedure coupled with a minimum of immobilization and bed confinement will appeal to all. KELLOGG SPEED.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

AMERICAN RED CROSS WORK AMONG THE FRENCH PEOPLE. By Fisher Ames, Jr. New York: The Macmillan Company, 1921.

THE AMERICAN YEAR-BOOK OF ANESTHESIA AND ANALGESIA. 1917-1918 edition. Edited by F. H. McMechan, M.D. New York: Surgery Publishing Co., 1920.

THE DISEASES OF THE NEWBORN. By Dr. August Ritter von Reuss. New York: William Wood & Company, 1921.

SURGERY, ITS PRINCIPLES AND PRACTICE. By Various Authors. Edited by William Williams Keen, M.D., LL.D. Vol. VII. Philadelphia and London: W. B. Saunders Company, 1921.

EPIDEMIC RESPIRATORY DISEASE; THE PNEUMONIAS AND OTHER INFECTIONS OF THE RESPIRATORY TRACT WHICH ACCOMPANY INFLUENZA AND MEASLES. By E. L. Opie, M.D. Francis G. Blake, M.D., James C. Small, M.D., Thomas M. Rivers, M.D. St. Louis: C.V. Mosby Co., 1921.

THE SEX-COMPLEX; A STUDY OF THE RELATIONSHIPS OF THE INTERNAL SECRETIONS TO THE FEMALE CHARACTERISTICS AND FUNCTIONS IN HEALTH AND DISEASE. By W. Blair Bell, B.S., M.D.(Lond.) 2d ed. New York: William Wood & Company, 1921.

DOEDERLEIN-KROENIG OPERATIVE GYNAEKOLOGIE. 4th ed. Leipzig: Georg Thieme, 1921.

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION. vol. xxxviii, 1920. Edited by John H. Jopson, M.D.

ELEMENTS OF SURGICAL DIAGNOSIS. By Sir Alfred Pearce Gould, K.C.V.O., M.S.(Lond.), F.R.C.S.(Eng.), and Eric Pearce Gould, M.D., M.Ch.(Oxon.), F.R.C.S.(Eng.) 5th ed. revised. New York: Paul B. Hoeber, 1920.

A TEXTBOOK OF GYNÆCOLOGICAL SURGERY. By Comyns Berkeley, M.A., M.C., M.D.(Cantab.), F.R.C.P.(Lond.), M.R.C.S.(Eng.), and Victor Bonney, M.S., M.D., B.Sc.(Lond.), F.R.C.S.(Eng.), M.R.C.P.(Lond.). 2d ed. New York: Paul B. Hoeber, 1920.

GYNECOLOGY. By Brooke M. Anspach, M.D. Philadelphia and London: J. B. Lippincott, 1921.

A Manual of Surgery; for students and practitioners. By Francis I. Stewart, M.D. 5th ed. Philadelphia: P. Blakiston's Sons & Company, 1921.

CORRESPONDENCE

ACUTE GAS-PRODUCING CHOLECYSTITIS

To the Editor: As a somewhat superficial search of recent literature and inquiry among surgeons of my acquaintance fails to reveal a similar case, this report is made.

4573–20. White male, age 44, admitted to Brooklyn Hospital, August 3, 1920. The patient had had typhoid and pneumonia in youth, and most of usual childhood diseases. General health has been good until the past 2 or 3 years, during which he has had indigestion characterized by gas and discomfort after meals, relieved by belching. No vomiting. No severe attacks. Bowels regular. Operation for chronic appendicitis 2 years ago with partial relief.

Three hours before admission patient was taken with sudden severe pain in right upper abdomen, excruciating and continuous, with vomiting and diarrhœa.

On admission to hospital patient was apparently in severe pain. There was board-like rigidity of upper abdomen with general abdominal tenderness most marked in epigastrium; no jaundice. Heart and lungs were negative. Temperature on admission was 98.1°, pulse 62, respiration 36.

Provisional diagnosis: perforated gastric ulcer.

Operation was performed 5 hours after onset. Incision was made through outer border of right rectus. No perforation of viscus or evidence of extravasation was found. A distended hæmorrhagic gall-bladder about 5 inches long was found and removed. Gall-bladder was not opened but felt as if filled with air. No other abnormal condition was found except slight omental adhesion to appendectomy scar. Closure with drainage.

Pathologist's report. Macroscopic examination shows a greatly distended gall-bladder 10 centimeters in length and 6 centimeters in diameter. The wall is dark bluish-red, the veins prominent, the serosa dull. The bladder has a crepitant sensation due to the presence of air. On opening, some dark brownish fluid is found in the bladder, but no stones. The wall is œdematous, the mucosa mottled and covered with grayish-green necrotic exudate.

Microscopic examination of sections show acute gangrenous cholecystitis.

Culture shows streptococcus and bacillus coli.

Post-operative course. Three hours after operation temperature was 101.5°, pulse 115, respiration 35. He ran a moderative febrile course, normal at end of one week. On the twelfth day his temperature began to rise and was of a mild typhoid type for 16 days when it dropped suddenly to normal and remained so. Epigastric pain and tenderness were present during this time. Widal negative. Two blood counts showed respectively 14,400 white blood cells with 86 per cent polynuclears, and 13,800 white blood cells with 85 per cent polymorphonuclears. Moderate seropurulent drainage and some superficial slough in the wound. An X-ray study on September 7 showed probability of a small gastric ulcer, just proximal to the pylorus.

Discharged September 23, 1920, with wound firmly healed but still having some epigastric pain after meals. Referred to stomach clinic.

Follow-up examinations showed steady gain in health and return to normal weight. Working regularly and has no pain but still some sensation of fullness in epigastrium after meals.

Comment. This case was apparently one of the frequent combinations of chronic appendicitis, cholecystitis, and ulcer, with an acute cholecystitis supervening. Effort to isolate the Welch bacillus by culture and animal inoculation failed. The unnatural lightness of the gall-bladder as it was held in the hand after removal was almost uncanny. I ascribed his postoperative fever course to an infection at the gall-bladder site, possibly a late leakage from the duct, though no bile appeared in the drainage.

Brooklyn. ERNEST K. TANNER, M.D., F.A.C.S

TREATING FRACTURES OF PATELLA BY MEANS OF SILVER WIRE

To the Editor: In the March number of SURGERY GYNECOLOGY AND OBSTETRICS, I notice a method described of treating fractures of the patella by means of pins. For many years I have been treating such fractures in much the same manner, using silver wire instead of pins. The ends of the wires are twisted over a piece of gauze until the fragments of bone are in close apposition. The ends of the wires are then bent over upon the gauze, and a splint and bandage applied. When the fragments are firmly united, one end of each wire is cut close to the skin and pulled out the other side.

D. A. ROBINSON.

Bangor, Me.

AMERICAN COLLEGE OF SURGEONS

HOSPITAL STANDARDIZATION

GRADUALLY the hospital standardization campaign of the American College of Surgeons has come to be a practical answer to the question as to how the people of the United States and Canada may protect for themselves the right to be well. The initiative in the work springs from the medical profession. Through definite and regular analyses of the care given to patients in hospitals the profession has brought about a swift reconstruction of its own responsibility, socially and scientifically, to the public; and the public has responded in turn with new interest in hospitals, with increased confidence in the physicians and surgeons engaged in the work, and with additional financial support toward all that these physicians and surgeons desire.

Hospital standardization aims to create conditions in the practice of medicine out of which every patient, however humble, may receive the highest service known to the profession. Through conscientious and fearless study of what happens to patients from month to month, it aims to do away with lax or lazy diagnoses and treatments, with unnecessary surgical operations, and with operations performed by unskilled surgeons. It aims to prevent avoidable mistakes from happening a second time; to create and to protect the right to be well for every man, woman, and child.

In order to give the program a definite and tangible beginning, the College proposed to the hospitals and to the medical profession, in 1917, a minimum standard of service to patients. It then employed visitors, or "inspectors," to present this standard to the hospital and doctors, and to explain what the standard is and what it means. The College did not assume authority to enforce the standard. At all times the College depends upon the sheer merit and soundness of its proposals to win and to hold the co-operation of those concerned in the work.

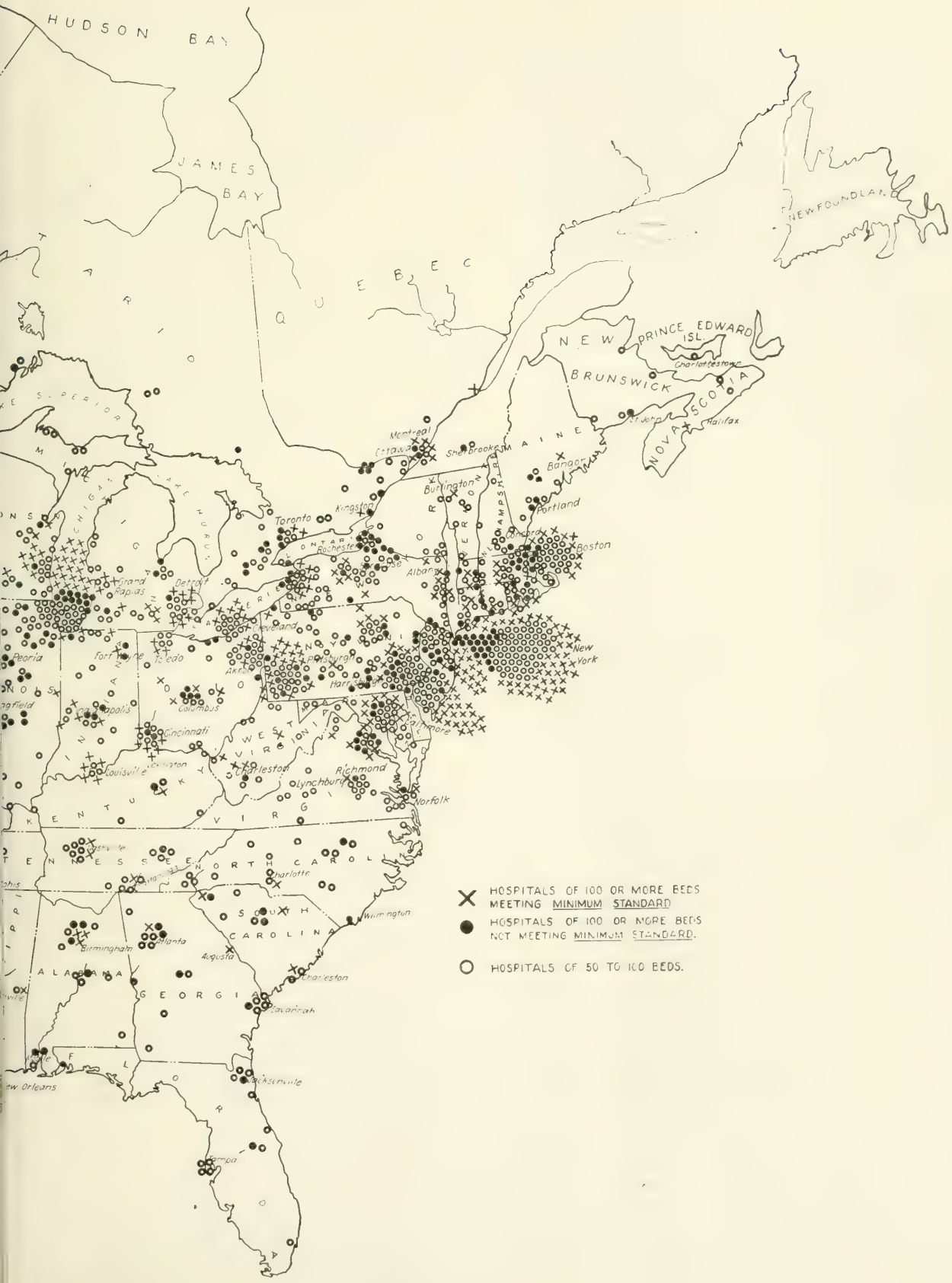
The minimum standard is not a formula nor a set of rules like recipes in a cookbook. It is, in effect, the statement of a principle. The principle is that those concerned in the care of the sick or injured shall bring their experience under regular review, and utilize their increased intelligence gained in this way for the better care of the sick or injured in the future.

The principle of hospital standardization means, then, that progress is forever a process of change. For example, the intelligent treatment of diphtheria today is quite a different treatment from what it was a generation ago. Right treatment of any illness is not a matter which can be settled once and for all time; rather it is a matter which is subject always to change and betterment. Always as a basis of progress the medical profession seeks to clarify what is obscure in its work, to trace consequences to their causes, to persist with sympathy and clear thought in order to find, if possible, the reason for each failure and then to take such action as seems best suited to prevent each failure from occurring again. When the members of a hospital staff, in dead earnest, work together in this way, they not only guarantee competent service to all patients in their hospital, but they put themselves into strong position to ask for the confidence, good will, and financial support of the public for the hospital. Further, such a program is lasting inspiration to the staff members, for it encourages personal initiative, freedom, and foresight.

If, now, physicians and surgeons are to review in a satisfactory manner their successes and failures in practice, they must have the facts upon which the successes and failures rest. Such facts are usually to be found in the case record of the various patients. It follows, then, that an adequate writing of case records is a fundamental necessity to the progress of the hospital. In fact, a hospital staff which does not with exacting care write its case records cannot review its own work; and if a staff does not review its own work and utilize the increased intelligence to be gained in this way, it cannot ask upon a rational basis for the good will of its patients or of its community.

There are sound reasons for the writing of case records other than their value for purposes of review, but we need not here discuss them. It is enough to say that an adequate case record system is included within the minimum standard as an imperative factor in good hospital service.

Vancouver
Seattle
Saskatoon
Regina
Winnipeg
Portland
Salem
Missoula
Billings
Boise
Grand Forks
Fargo
Minneapolis
Aberdeen
Sioux Falls
Casper
Laramie
Cheyenne
Omaha
Lincoln
Des Moines
Denver
Topeka
Kansas City
Los Angeles
San Diego
Albuquerque
Oklahoma City
Dallas
Houston
San Antonio


HUDSON BAY
JAMES BAY
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
PRINCE EDWARD ISL.
NOVA SCOTIA
Charlottetown
St John
Halifax
Montreal
Ottawa
Sherbrooke
Bangor
Portland
Burlington
Kingston
Toronto
Rochester
Albany
Boston
Detroit
Grand Rapids
Cleveland
Pittsburgh
Akron
Harrisburg
New York
Peoria
Fort Wayne
Toledo
Columbus
Cincinnati
Louisville
Charleston
Richmond
Lynchburg
Norfolk
Charlotte
Wilmington
Birmingham
Atlanta
Augusta
Charleston
Savannah
Jacksonville
Tampa
New Orleans
HOSPITALS OF 100 OR MORE BEDS MEETING MINIMUM STANDARD
HOSPITALS OF 100 OR MORE BEDS NOT MEETING MINIMUM STANDARD.
HOSPITALS OF 50 TO 100 BEDS.

ANALYSIS OF HOSPITAL SERVICE

for month ending.....

DISCHARGED

Cured
Improved
Relieved
Unimproved
To return for secondary operation
Admitted for diagnosis only
Deaths within 48 hours
Deaths institutional after 48 hours)
Released
Labor
Newborn
.....
.....
Total discharged

DIAGNOSES

Provisional and final agree
Provisional and final disagree
Discharged with additional diagnosis
Discharged with no diagnosis made
Labor
Newborn
.....
.....
Total discharged

INFECTIONS

Institutional		On Admission	
Medical		Medical	
Surgical		Surgical	
Obstetrical		Obstetrical	

Total infections

CONSULTATIONS

Asked and obtained
Asked, not obtained
Indicated, not asked
.....

DEATHS		AUTOPSIES	
Medical		Medical	
Surgical		Surgical	
Obstetrical		Obstetrical	
Newborn		Newborn	
Stillborn		Stillborn	

Total deaths | Total autopsies

CAUSES OF DEATHS

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

Total deaths

UNIMPROVED

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

Total unimproved

Again, adequate laboratory service is included in the minimum standard. This requirement needs no explanation. It is today unthinkable that a hospital through its staff should attempt to study and treat illness or injuries without the facilities of a clinical laboratory.

Again, as fundamental to good hospital service it is assumed that men privileged to practice in each hospital are scientifically trained and high-minded. The evil of the division of fees became some years ago so prevalent that the College included a restriction against this practice in the minimum standard.

To summarize, the minimum standard is a statement of a practicable, workable, and constructive plan for hospital betterment. It is a standard that safeguards the care of every patient admitted to the hospital by insistence upon competence on the part of the doctor, upon thorough study and diagnosis in writing for each case, upon efficient laboratory work, and upon a checking up, at least once each month, of the clinical service rendered in the hospital. It fixes responsibility throughout the hospital. It calls for the "production sheets" of the hospital, but does not cause in any way violation of the confidential relationship between the doctor and his patient. It encourages and even compels research. It costs effort rather than money. It defines the minimum service to the patient, which beyond all debate, is essential.

The plan of hospital standardization, as has already been stated, is the working out of a principle and not the application of a set of rules. It is a plan by which physicians and surgeons are able to pledge right service to patients, not upon sentimental ground but upon ground that is altogether defensible and creditable.

THE ANALYSIS OF SERVICE

During these days much thought is being given to find the most effective means to review the clinical work of the hospital. The data as indicated on page 472 are found by a number of hospitals to be of stimulating value when presented to the staffs.* Copies of these data are placed in the hands of each member of the staff; point by point the data are reviewed and the responsibility for the character of the data is shared by each staff member.

In order to compile the data called for on the sheet, it is suggested that a daily review be made of the records of patients discharged. This review will include information under each of the headings of the sheet. When a daily record is kept in this fashion, the summary for the month is merely a matter of arithmetic.

From time to time exhibits are made showing these data comparatively through a series of months. In addition to these data some definite report of the laboratory service of the hospital is helpful. This report should show the extent to which the laboratory is used; and in this connection questions as to the adequacy and competence of the laboratory service should be raised by the staff. The staff should especially recognize good work on the part of the pathologist. All gross material removed at operations should go to the pathologist for report; and the case record of each death in the hospital together with the autopsy record, when available, should be presented as a routine at the next succeeding staff meeting.

THE SURVEY OF 1920

During the last three years the College has each year made surveys of the 697 general hospitals of 100 or more beds in the United States and Canada, measuring the extent to which these hospitals fulfill the minimum standard. The list of approved hospitals contains the names of 407 institutions.

The advance which hospitals have made during these years is indicated by the following figures: Two years ago 89 out of these 697 hospitals fulfilled the minimum standard; one year ago 198 out of the 697 met the standard; at the present time 407 of the group meet the standard.

During the past year about 300 of the 965 general hospitals having from 50 to 100 beds were personally inspected by staff members of the College. No report of the findings among these hospitals is made at this time, as this work is still incomplete.

The three surveys made by the College were accomplished by means of personal visits to the hospitals by staff members of the College. These men, all graduates in medicine, went to the hospitals not as unwelcome visitors but rather as engineers, discovering first what the shortcomings of the institution were in relation to the minimum standard and then indicating how such shortcomings might best be overcome. The council meetings held at the various hospitals by these inspectors proved to be an important element in the success of the work.

THE MINIMUM STANDARD

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as

*Credit for aid in preparation of this form is due Superintendent Frank E. Chapman, Mt. Sinai Hospital, Cleveland.

File No.

AMERICAN COLLEGE OF SURGEONS

CHICAGO

Date.....

Visitor.....

Hospital..... Capacity..... Internes.....

Address..... Type..... Grad. nurses.....

Superintendent..... Affiliation..... Pupil nurses.....

I. STAFF ORGANIZATION

1. Does staff meet at regular intervals?.....
2. If so, how often?.....
3. Does staff consider character of work relative to right care of patients?.....
4. Is the division of fees officially prohibited?.....

II. CASE RECORDS

	FREE	PAY	PRIVATE
Personal History			
Physical Examination			
Working Diagnosis			
Laboratory Findings			
Treatment or Operation			
Progress Notes			
Final Diagnosis			
Condition on Discharge			

Notes.....

.....

.....

III. CLINICAL LABORATORIES

	IN HOSPITAL	OUT OF HOSPITAL
Chemical		
Bacteriological		
Serological		
Histological		
Radiographic		
Fluoroscopic		

Head Lab. Technician: Trained..Full-Time..Part-Time..

X-Ray Lab. Technician: Trained..Full-Time..Part-Time..

Records kept in lab: Pathological.....X-Ray.....

Notes.....

.....

.....

(Reverse side of card)

IV. AUTOPSIES

1. No. of deaths in last year..... No. of autopsies.....
2. Does pathologist meet with staff to review clinical history in relation to autopsy findings?.....

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Notes.....

V. GENERAL NOTES

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VI. PERSONS INTERVIEWED AND THEIR POSITION

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to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide:

a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

b. That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnoses, and treatment of patients, these facilities to include at least chemical, bacteriological serological, histological, radiographic, and fluoroscopic service in charge of trained technicians.

THE DATA COLLECTED

The work of the hospital visitors of the College is to collect exact information as to the extent to which each hospital visited fulfills the minimum standard. The visitor's card as shown on page 474 indicates the manner in which the data are recorded. On the face of the card the visitor reports concerning staff meetings, case records, and laboratory service; on the reverse side of the card, concerning number of deaths, autopsies, and the extent to which the clinical histories in relation to autopsy findings are reported to the staff. General notes and the names and positions of persons interviewed by the visitor are also recorded.

STATE CLINICAL MEETINGS

MEETINGS of state sections of the Clinical Congress of the American College of Surgeons were held during March for the state of Nebraska at Omaha, March 3 and 4; for Kansas at Wichita, March 7 and 8; for Missouri at St. Louis, March 10 and 11; for Tennessee at Nashville, March 21 and 22, for Kentucky at Louisville, March 25 and 26. At each meeting there were clinical, scientific, and public sessions and a hospital conference on standardization. The programs follow:

NEBRASKA

THURSDAY, MARCH 3

Clinics

At the St. Joseph, Methodist, Clarkson, Immanuel, Swedish Mission, Wise Memorial, and University Hospitals, 8 a.m. to 12 m.

Hospital Conference, 10 a.m.

John E. Summers, M.D., Chairman, Nebraska State Section, Presiding.

The Hospital Program of the American College of Surgeons, and the Meaning of the Minimum Standard—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—Irving S. Cutter, M.D., Dean of the University of Nebraska College of Medicine.

Discussion—Opened by H. von W. Schulte, M.D., Dean of the Creighton College of Medicine.

Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—A. R. Mitchell, M. D., Lincoln.

Discussions—Opened by Delmar L. Davis, M.D., Omaha.

Scientific Session, 2 p.m.

Symposium on Cancer

Pathology and Etiology—Burton T. Simpson, M.D., Buffalo, N. Y.

Discussion—Opened by C. C. Hilton, M.D., Lincoln.

Tissue Diagnosis—Wm. C. MacCarty, M.D., Rochester, Minn.

Discussion—Opened by H. E. Eggers, M.D., Omaha.

Radiology—Daniel T. Quigley, M.D., Omaha.

Discussion—Opened by A. I. MacKinnon, M.D., Lincoln.

Cancer of the Breast—B. B. Davis, M.D., Omaha.

Discussion—Harry M. Hepperlen, M.D., Beatrice, Nebr., and William C. MacCarty, M.D., Rochester, Minn.

Cancer of the Uterus—Palmer Findley, M.D., Omaha.

Radiotherapy vs. Radical Operation for Cancer of the Uterus—George Gellhorn, M.D., St. Louis, Mo.

Public Meeting, 8 p.m.

J. E. Summers, M.D., Chairman, Nebraska State Section, Presiding.

Invocation—Rev. Frank Smith, Omaha.

Address of Welcome—Mayor E. Smith, Omaha.

Program of the American College of Surgeons—Harold M. Stephens, Director of Hospital Activities American College of Surgeons.

What the Public Should Know About Disease—A. F. Jonas, M.D., Omaha.

Campaign on Cancer—Francis Carter Wood, M.D., New York.

Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

FRIDAY, MARCH 4

Clinics

At the Presbyterian, St. Catherine's, Methodist, Clarkson, Immanuel, Swedish Mission, Wise Memorial, University, Radium, and St. Joseph's Hospitals, 8 a. m. to 12 p.m.

Scientific Session, 2 p.m.

Symposium on Gastric and Duodenal Ulcer

Etiology (Symptoms and Medical Treatment)—E. L. Bridges, M.D., Omaha.

Discussion—Opened by A. R. Mitchell, M.D., Lincoln.

X-Ray in Diagnosis—James T. Case, M.D., Battle Creek, Mich.

Discussion—Opened by Stuart A. Campbell, M.D., Norfolk.

Indications for Surgical Treatment—A. F. Jonas, M.D., Omaha.

Discussion—Opened by P. H. Salter, M.D., Norfolk.

Operative Treatment—J. E. Summers, M.D., Omaha.

Discussion—Opened by A. C. Stokes, M.D., Omaha.

Postoperative Treatment—J. Stanley Welch, M.D., Lincoln.

Discussion—Opened by George Pratt, Omaha. Nebr.

Symptoms and Treatment of Gastrojejunal Ulcer.—Delmer L. Davis, M.D.

Discussion—Opened by William C. MacCarty, M.D., Rochester, Minn.

Etiological Factors in Gastrojejunal Ulcer—C. A. Roeder, M.D., Omaha.

Women's Public Meeting, 4 p.m.

Popular Talk on Cancer—Burton T. Simpson, M.D., Buffalo, N.Y.

The Cancer Problem (illustrated by slides)—Palmer Findley, M.D. Omaha.

KANSAS

MONDAY, MARCH 7

Clinics

At St. Francis and Wesley Hospitals, 9 a.m. to 12 m.

Hospital Conference, 2:30 p.m.

Charles E. Bowers, M.D., Chairman, Kansas State Section, Presiding.

The Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—Charles E. Bowers, M.D., Wichita.
Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—S. G. Ascher, Superintendent, Wichita Hospital.
Discussion—Opened by Harry W. Horn, M.D., Wichita.

Public Meeting, 8 p.m.

C. E. Bowers, M.D., Chairman, Kansas State Section, Presiding.
Address of Welcome—Henry J. Allen, Governor of Kansas.
The Program of the American College of Surgeons—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
What the Public Can Do to Increase the Good Results in Surgery—Allen B. Kanavel, M.D., Chicago, Professor of Surgery, Northwestern University Medical School, Chicago.
Why the Church Believes in Medical Education of the Laity. Rev. W. M. Farrell. Rev. Otis Grey, and Rev. H. C. Herring, Jr.

TUESDAY, MARCH 8

Clinics

At St. Francis and Wichita Hospitals, 9 a.m. to 12 m.

Scientific Session, 2:30 p.m.

Clinical Experiences and Investigative Studies in Tic Douloureux and Allied Neuralgias. Allen B. Kanavel, M.D., Professor of Surgery, Northwestern University. Medical School, Chicago.
Some Postoperative Complications—Harry W. Horn, M.D., Wichita.
The Interposition Operation for Descensus Uteri and Cystocele—D. W. Basham, M.D., Wichita.

MISSOURI

THURSDAY, MARCH 10

Clinics

At the Barnes, Jewish, St. Anthony's, St. John's, St. Louis City, and St. Luke's Hospitals, and the Missouri Baptist Sanitarium, 9 a.m. to 12 m.

Hospital Conference, 2 p.m.

Harvey G. Mudd, M.D., Chairman, Missouri State Section, Presiding.
The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—Major G. Seelig, M.D., St. Louis.
Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—L. H. Burlingham, Superintendent, Barnes and St. Louis Children's Hospitals.
Discussion—Opened by Evarts A. Graham, M.D., St. Louis.

Public Meeting 8:30 p.m.

H. G. Mudd, M.D., Chairman, Missouri State Section, Presiding.
Address of Welcome—Honorable Frederick W. Lehmann.
Surgical Researches in Peace and War—George W. Crile, M.D., Cleveland, Ohio.
Program of the American College of Surgeons,—Judge Harold M. Stephens, Director of American College of Surgeons.
Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

FRIDAY, MARCH 11

Clinics

At the Barnard Skin and Cancer, Barnes, Jewish, St. John's, St. Louis City, Mullanphy, St. Luke's, and St. Mary's Hospitals, and the Missouri Baptist Sanitarium, 9 a.m. to 12 m.

Scientific Session, 2:30 p.m.

Laryngectomy—N. B. Carson, M.D.
The Rôle of the Liver in Abdominal Operations—George W. Crile, M.D., Cleveland, Ohio.
Some Surgical Odds and Ends—J. F. Binnie, M.D., Kansas City.

TENNESSEE

MONDAY, MARCH 21

Clinics

At the St. Thomas, Protestant, and Woman's Hospitals and Dr. Barr's Infirmary, 8:30 a.m. to 12:30 p.m.

Hospital Conference, 2:30 p.m.

W. A. Bryan, M.D., Chairman, Tennessee State Section, Presiding.
The Meaning of the Minimum Standard—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Soul of Standardization—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—W. D. Haggard, M.D., Nashville.
Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—Mr. Joseph Purvis, Superintendent, Methodist Hospital, Memphis.
Discussion—Opened by E. Dunbar Newell, M.D., Chattanooga.

Public Meeting, 8 p.m.

Hon. Alfred A. Taylor, Governor of Tennessee, Presiding.
The American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Early Recognition of Cancer—V. P. Blair, M.D., F.A.C.S., Associate Professor of Surgery, Washington University, St. Louis.
The Relation of the Surgeon to the Public—William R. Cubbins M.D., Associate Professor of Surgery, Northwestern University, Chicago.
The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.
Community Health as a National Asset—Professor G. A. Dyer.

TUESDAY, MARCH 22

Clinics

At the St. Thomas, Protestant, and Woman's Hospital, and Dr. Barr's Infirmary, 8:30 a.m. to 12:30 p.m.

Scientific Session, 2:30 p.m.

W. A. Bryan, M.D., Chairman, Tennessee State Section, Presiding.
The Operative Treatment of Fractures—Battle Malone, M.D., Memphis.
The Present Status of the Operative Treatment of Fractures—William R. Cubbins, M.D., Chicago.
Delayed Transplantation of Pedicle Flaps—V. P. Blair, M.D., St. Louis.

KENTUCKY

FRIDAY, MARCH 25

Clinics

At the City, Children's Free, Deaconess, St. Anthony, and Sts. Mary & Elizabeth Hospital, and The Norton Memorial, and St. Joseph's Infirmaries, 8:30 a.m. to 12:30 p.m.

Hospital Conference, 2:30 p.m.

Lewis S. McMurty M.D., Chairman, Kentucky State Section, Presiding.
The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—Irvin Abell, M.D., Louisville.
Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—Henry E. Tuley, M.D., Louisville.
Discussion—Opened by A. T. McCormack, M.D., Louisville.

Public Meeting, 8 p.m.

Hon. Edwin P. Morrow, Governor of Kentucky, Presiding.
The American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons, Chicago.
Surgical Researches in Peace and War—George W. Crile, M.D., Professor of Surgery, Western Reserve University School of Medicine, Cleveland.
The Hospital and the Community—Carl B. Davis, M.D., Assistant Professor of Surgery, Rush Medical College, Chicago.
The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of Catholic Hospital Association, Milwaukee.
How You Can Make Louisville a Health Center—A. T McCormack, M.D., State Health Officer of Kentucky, Louisville.

SATURDAY, MARCH 26

Clinics

At the Children's Free, City, Deaconess, St. Anthony, and Sts. Mary and Elizabeth Hospitals, and the Norton Memorial, and St. Joseph's Infirmaries, 8:30 a.m. to 12:30 p.m.

Scientific Session, 2:30 p.m.

L. S. McMurtry, M.D. Chairman, Kentucky State Section, Presiding.
The Rôle of the Liver in Abdominal Operations—George W. Crile, M.D., Cleveland.
Surgery of the Large Bowel—Carl B. Davis, M.D., Chicago.
Preparatory Treatment of Prostatectomy—J. H. Blackburn, M.D., Bowling Green.

MEETINGS TO BE HELD

Indiana—Indianapolis, May 2 and 3.
Joint Meeting, Maryland and District of Columbia—Baltimore and Washington, May 10 and 11.
Massachusetts—Springfield, May 13 and 14.
Connecticut—New Haven, May 23 and 24.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXII JUNE, 1921 NUMBER 6

THE RECONSTRUCTION OPERATION FOR UNUNITED FRACTURE OF THE NECK OF THE FEMUR

BY ROYAL WHITMAN, M.D., F.A.C.S., NEW YORK

I THINK it will be admitted that the results of fractures in general are determined primarily by the efficiency of the treatment in correcting deformity and in apposing displaced fragments. And that the greater the obstacles to repair, whether mechanical or nutritive, the more directly is success dependent upon favorable opportunity. It follows, therefore, that the exceptionally bad results that distinguish fracture of the neck of the femur from all the other injuries of its class are due primarily to the inadequacy of conventional treatment to assure the essentials of functional repair.

Non-union, which is the rule, if the fracture is of the central type, as of the patella and olecranon, is caused primarily by separation of the fragments. These are of small area lying in a lateral relation to one another. They can be apposed therefore, only by placing the limb in the attitude of full abduction, because the fragments are thus brought end to end, so that security may be maintained by mutual pressure. Accurate adjustment and secure fixation are in this instance essential to repair, because it must proceed from the interior unaided by external callus.

In fractures at the base of the neck, the larger area of the fragments and the better blood supply favor repair. Yet, according to a leading treatise on fractures, "the first indication is to save life, the second to get union, the third to correct or diminish displacements." Thus function becomes the last consideration, since normal movement in a joint requires normal relation of its component parts.

At the hip the range of motion is determined by the angle of the neck of the femur. If the angle is lessened, abduction is correspondingly restricted by contact of the upper border of the neck with the rim of the acetabulum, or if the neck is materially shortened, by impact of the trochanter at this point. If its forward inclination is lost, the limb is rotated outward and the range of flexion is restricted.

Depression and backward distortion of the neck (coxa vara) is the characteristic primary and persistent deformity of the "extracapsular" fracture, since it is rarely corrected by design or incidentally by treatment (Fig. 1). This deformity causes direct and apparent shortening of the limb; for since the range of abduction is insufficient for functional requirements, it is supplemented by a tilting upward of the pelvis on the affected side.

Repair of fractures in this region is very slow and because of its projection from the shaft, the neck of the femur is subjected to greater strain than are other bones. Furthermore the joint is often involved in a form of sympathetic arthritis, as indicated by sensitiveness to weight-bearing, to passive movements, and by restriction of voluntary motion by what is called muscular spasm, the

Fig. 1. Fracture at the base showing extreme coxa vara. It may be noted that the neck is in the position of full abduction, indicating clearly that if the shaft had been abducted at the time of the injury symmetry would have been restored.

most significant indication of instability of repair.

If functional use, particularly weight-bearing, is permitted before the fracture is consolidated, the primary deformity may be increased as in the progressive stage of coxa vara, or it may induce excessive callus formation without, or nutritive changes within the joint. Furthermore, whenever the injured part is unequal to the strain put upon it, the limb instinctively assumes the attitude of protection, namely adduction and flexion, and muscular contraction and shortening increase and confirm the distortion.

Lack of protection, which is characteristic of conventional practice, is therefore one of the important factors of what is now considered inevitable disability. For in the words of an authority, "In all cases function is forever impaired, shortening of the limb and lameness are the inevitable results."

Ununited fractures fall below the standard of average disability. In most instances crutches are required in locomotion. There is usually discomfort on changing from rest to activity and often severe pain at night, caused apparently by friction or interlocking of the fragments. Occasionally the capsule or the fibrous union or the interlocked fragments may be sufficiently resistant to assure stability, but there is usually a tendency to further displacement with consequent increase of functional disability (Fig. 2). As a rule the discomfort is the greatest in the cases in which the fragments are fairly apposed, thus offering an opportunity for friction, and the disability more extreme when they are widely separated by upward displacement of the shaft upon the pelvis with consequent distortion of the limb (Fig. 3). Operative treatment offers the only prospect of definite relief, but thus far it has been practically limited to attempts to secure direct union of the fragments. In this operation the essentials of success are that the neck be long enough to permit a sufficient range of abduction, and that on removal of the fibrous tissue, the surface of each fragment shall bleed freely. Under these conditions if they are accurately apposed by abducting the limb to the proper degree and fixed by a bone peg, union is fairly certain, indicating that if the abduction method, the only efficient means of treating this fracture, had been applied originally, the secondary operation would have been unnecessary.

In a large proportion of the cases this treatment is impracticable because the patients are not seen until long after the injury—when the neck fragment has practically disappeared and when the circulation has been greatly reduced by the atrophy of disuse (Fig. 4). Furthermore the treatment must be adapted to the individual as well as to the local condition. The majority of the patients are elderly subjects who are often mentally as well as physically depressed by a painful disability of long standing. If an operation is to be undertaken, they desire above all the assurance of relief from discomfort, and restoration of weight-bearing capacity in a definite time. The limb is atrophied, the circulation is poor and the joints often stiffened from disuse—secondary repair is a very slow

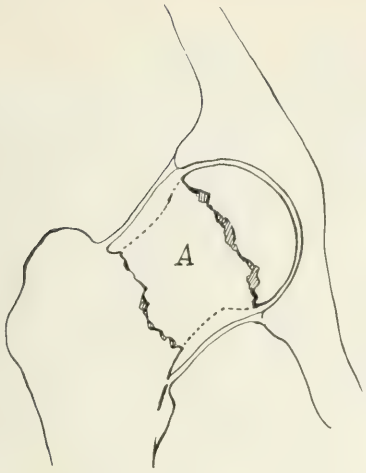


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2. *a*. The area of the neck that is usually "absorbed" in ununited fractures of long standing.

Fig. 3. The relation of the fragments in the ordinary type of ununited fracture. The shaft of the femur is displaced upward and adducted.

Fig. 4. The fragments are apposed for direct repair, illustrating contact of the trochanter with the rim of the acetabulum, which checks abduction of the limb and causes functional disability, even when union is attained.

process—the outcome is uncertain and the functional result imperfect because of the degenerative changes involving the components of the joint.

As a practical illustration of the limited field for operations of this type, a recent report of 120 cases of ununited fracture at the hip observed at the Mayo clinic may be cited. Although in the majority of the cases the patients were physically favorable subjects for operation, it was considered advisable in but 26, and in these the functional result was satisfactory in 10, or but 8 per cent of the patients applying for relief.[1] Brackett[2] has described a modification of this form of operation. The extremity of the trochanter having been removed, its inner and upper surface is forced against the head in which a corresponding concavity has been cut, by sufficient abduction of the limb. The result in the cases reported was satisfactory, but the operation has the disadvantage that success is dependent upon the capacity of the tissues for repair, while at best the functional result must be imperfect (Fig. 5).

In the great majority of cases direct union is doubtful and thus far the alternatives have been to remove the head of the femur and either to implant the upper extremity of the shaft in the acetabulum (Fig. 6), or to cut through the trochanter and to force it outward sufficiently to permit a more complete enclosure of the extremity of the neck in the acetabulum (Fig. 7). The trochanter being ill adjusted to the acetabulum is liable to displacement if motion is permitted, and in both instances there is complete loss of leverage for the abductors, therefore lessened muscular control and a consequent tendency toward flexion and adduction of the limb.

The procedure that I present is called a reconstruction operation, because it is designed to restore, as far as may be, the mechanical conditions required for security and controlled movement.

An incision is made in the shape of a half U, beginning about 1 inch behind the anterior superior (Fig. 8) spine and extending downward and backward, crossing the femur at a point 3 inches below the apex of the trochanter. The interval between the tensor vaginæ femoris and gluteus medius muscles is exposed; the capsule is opened and the head of the femur is removed (Fig. 9).

The anterior margin of the gluteus minimus is followed to its insertion, and at this point with a wide, thin chisel, the base of the trochanter is cut through in an oblique direc-

[1] Henderson. Surg., Gynec. & Obst., 1920, xxx.

[2] Boston M. & S. J., 1917, clxxvii.

Fig. 5.

Fig. 5. Brackett's operation. From roentgenogram "3 months after operation showing solid union between trochanter and head." The angle of abduction is about 40 degrees, and if this relation of the shaft and head persists it would appear that function must be seriously impaired, because with the limb in the line of the body the head must be displaced from the acetabulum.

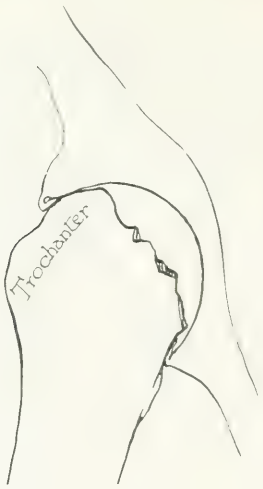


Fig. 6.

Fig. 6. The disadvantages of implanting the trochanter in the acetabulum after removal of the head are: ill adjustment, insecurity, and loss of motion.

Fig. 7.

Fig. 7. The trochanter is displaced outward to permit the inclusion of the neck in the acetabulum (Albee), illustrating the limited area of support, the limitation of abduction and loss of muscular control.

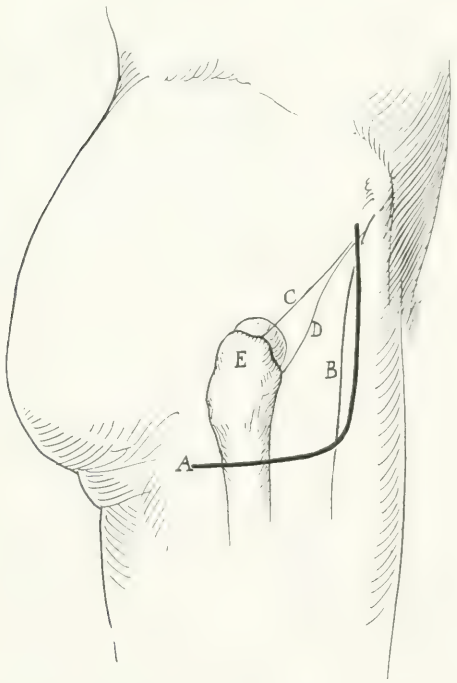


Fig. 8. *a*, Line of incision; *b*, the tensor fascia femoris; *c*, the anterior margin of the gluteus medius; *d*, the anterior margin of the gluteus minimus; *e*, the trochanter.

tion corresponding to the angle of the neck, including all its muscular attachments and often a part of the capsule. This flap of bone and muscle is turned upward and the upper extremity of the femur, having been somewhat remodeled by cutting away the projections of the posterior intertrochanteric line, is freed from any restraining tissues and is thrust completely within the acetabulum at an angle of about 25 degrees of abduction (Figs. 10 and 11).

The trochanter is then drawn downward, as far as its attachments will permit, and sufficient cortex having been removed from the lateral aspect of the femur, the two bare surfaces are apposed, the axis of the trochanter being thereby changed from a direction upward and inward, to outward and upward. In this position it is secured, either by a drill or a peg, but usually by suture passed through the bones. The wound is closed in layers and a long plaster spica is applied fixing the limb in extension and abduction. When repair has sufficiently advanced, or in about 4 weeks, this may be replaced by a short spica and the patient is encouraged to bear weight in order to hasten the reconstruction of the articula-

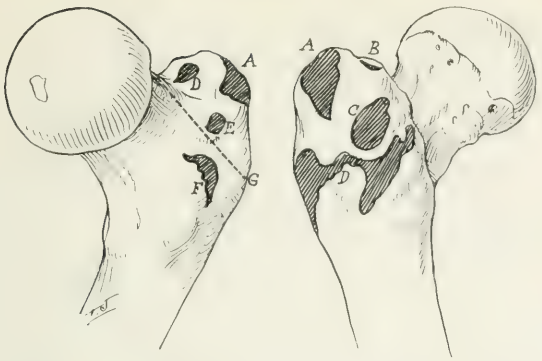
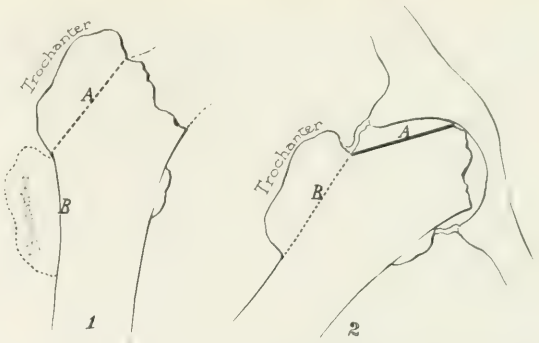


Fig. 9. The muscular attachments of the trochanter. At left, the posterior and internal surface of the trochanter. *a*, Gluteus medius; *d*, obturator internus pyriformis, and gemelli; *e*, obturator externius; *f*, quadratus femoris: *g*, line of section. At right, the anterior and external surface of the trochanter. *a*, gluteus medius; *b*, pyriformis-obturator internus and gemelli; *c*, gluteus minimus; *d*, vastus.



Figs. 10 and 11. The reconstruction operation. Figure 10 (at left), the line of section of the trochanter and the point on the shaft to which it is to be transferred. Figure 11, the reconstructed neck.

tion by a functional adaptation of the limb to the new conditions. When weight may be borne without discomfort, the support is removed and muscular control is re-established by systematic exercises (Fig. 12).

As illustrating the types of cases for which the operation is adapted, the following may be cited:

Case 1. The first reconstruction operation was performed on October 10, 1916. The patient, a woman age 60, had been transferred to the Hospital for the Ruptured and Crippled from another hospital, where she had been under treatment for 7 months, for fracture of the neck of the femur (Fig. 13). She was completely disabled and suffered almost constant pain. In 6 months after the operation she was able to resume her work, and has since been as active as ever. A final examination was made on November 10, 1920. The patient walks with but slight limp and without discomfort. The shortening of 1½ inches is less than that before the operation. The limb is under perfect muscular control; there is a range of 70 degrees of voluntary flexion from complete extension and of abduction to 20 degrees (Fig. 14).

Case 2. A woman, age 53, sustained a fracture of the neck of the right femur in February, 1917. She was treated efficiently, but the fragments, though in contact, did not unite. She suffered constant pain and was on that account obliged to pass part of each night in a chair. The operation was performed on August 21, 1919. The patient is not a resident of New York and has not been examined since leaving the hospital, but writes that muscular control is established, that she is free from pain, and walks with but moderate limp.

In these two cases the indications were to relieve pain and to restore earning capacity.

Case 3. A woman, age 57, was operated on in July, 1920. The neck of the left femur had been broken 4 months previously, but no diagnosis had been made, and no treatment other than osteopathic manipulation had been employed. She suffered pain on movement and was almost completely disabled. In this instance the plaster support was removed in 4 weeks and active movement encouraged. The patient left the hospital at the end of 7 weeks walking with crutches, free from pain, able to support weight on the limb, with almost free passive movement and a fair degree of voluntary control (Fig. 15).

Fig. 12. The relation of the reconstructed neck to the acetabulum in locomotion, and the leverage assured for the abductors. Contrast with Figures 6 and 7.

Fig. 13. Case 1 before operation, showing complete "absorption" of the neck.

Fig. 14. Case 1 after operation, showing the security of the new articulation. In this case the cortex of the shaft was simply turned backward and a nail was used to fix the transplanted trochanter.

This case is of interest because the short interval from the time of the injury would seem to indicate bone pegging. The neck of the femur had been, however, almost entirely destroyed and the decision of the patient was for an operation which assured relief of pain and restoration of the weight-bearing capacity, in preference to a treatment which, even if successful, required long confinement and persistent after-care. In this connection it may be stated again, that in my opinion, if complete statistics were available, the uncertainty of repair after bone pegging in fracture of the neck of the femur would be clearly demonstrated. Furthermore, that in successful cases the period of repair is much longer and the functional results far less satisfactory than the reports of favorable cases would indicate.

Fig. 15. Case 3, showing the reconstructed neck and transplanted trochanter.

Case 4. A woman, age 52, was operated upon in September, 1920, one year after fracture at the right hip. The limb was flexed and adducted, and movements were painful. This operation seemed particularly indicated, because the patient's wrists and fingers were involved in rather advanced arthritis deformans interfering with the use of crutches. She is now able to support weight on the limb without discomfort.

Case 5. A man, age 45, suffering from locomotor ataxia of 10 years' duration, which according to his

Fig. 16. Case 6, before operation, showing complete loss of the neck.

Fig. 17. Case 6, after operation, showing the articulation.

account did not interfere materially with locomotion, sustained a fracture at the right hip in December, 1919. He was taken immediately to a hospital where Steinmann's nails were inserted for traction which was continued for 3 weeks only. In April the joint was opened, apparently with the design of pegging the neck, but the operation was not completed. The patient was completely disabled by the fracture and by general weakness incidental to confinement and the underlying disease, and as direct repair in this class of cases is considered improbable, the reconstruction operation was performed on June 30, 1920. Support was removed at the end of 8 weeks, and the patient now walks well with crutches with comparative freedom of control and security of support.

Case 6. A woman, age 60, fractured the right hip in March, 1919. She received the routine treatment for 8 weeks, followed by the usual history of discomfort and pain, when function was resumed. For 2 months a hip splint was worn but was discarded because of the weight. The reconstruction operation was performed in October, 1920; the plaster spica was removed 4 weeks later and exercises were begun.

These cases emphasize a point which, I think, is not generally appreciated, that ununited fracture of the neck of the femur is in most instances a painful as well as a crippling condition, for which in vigorous subjects, operative treatment would be advised and accepted, if definite relief could be assured (Figs. 14 and 15). From this standpoint the reconstruction operation has a great advantage over bone grafting in cases of the ordinary type, while its technical superiority over the alternative procedures should be apparent. The removal of the trochanter restores a bearing surface for the femur by reconstructing a neck, which when remodeled may be adjusted to the acetabulum to form a stable articulation. The displacement of the trochanter to a lower attachment on the femur in the attitude of abduction provides a muscular sling, whose tension supports the limb in its proper relation to the pelvis, while its outward projection restores effective leverage for the attached muscles, of which the glutei, the direct abductors of the limb, are the most important. Thus, comparative freedom of controlled movement, and security in weight-bearing are assured.

The reconstruction operation is designed primarily for cases of ununited fracture in which bone grafting seems impracticable, a

class which under present conditions includes the majority of all patients. I am of the opinion, however, that the immediate and efficient treatment of fracture of the neck of the femur by the abduction method[1] will be followed in most instances by repair, and that if union fails when accurate apposition of the fractured surfaces has been maintained for a sufficient time, as confirmed by X-ray examination, it indicates a low vitality of the tissues, and therefore the advisability of the reconstruction operation in preference to bone grafting.

At the present time only a small proportion of the patients are treated efficiently at the time of the injury and the field for both bone grafting and the reconstruction operation is much greater than it will be, I trust, in the future.

It may be mentioned in conclusion, that this type of operation is serviceable for other conditions than ununited fracture. For example, as a substitute for the arthrodesis in advanced arthritis deformans; for restoring motion in cases of ankylosis, particularly of the bilateral form, cases in which plastic operations are usually disappointing, either because the joint again becomes fixed, or because of discomfort and eventual distortion of the limb; also in certain cases in which as the result of destructive disease of the joint there is upward displacement of the shaft.

[1] The abduction method is described in Surg., Gynec. & Obst., 1918, xxvii, 578.

POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG[1]

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THE seven cases of postoperative massive collapse of the lungs, here reported, occurred in a series of 540 consecutive operations over a period of one year. The operations were carried out under identical circumstances as regards operator, anæsthetist, and postoperative care. The patients were all men, nearly all between the ages of 18 and 40, three or four only were over 50.

The operations performed included all the usual conditions of post-war surgery. Of the 540 cases, 84 were operated on for some abdominal condition, 35 appendicectomies, 40 inguinal hernias, 5 repair of hernias of abdominal wall, the result of wounds of the abdomen, 1 gastric ulcer, 2 cholecystectomies, 1 sarcoma of bowel. Twenty-three were operated on for hæmorrhoids.

Six of the collapse cases were among those operated on for inguinal hernia or acute appendicitis, one among those operated on for hæmorrhoids. Four were operated on for inguinal hernia, 2 for acute appendicitis. Of the hernia cases, 3 were right-sided. In 2 of these the lung collapse was on the right side, in 1 on the left. In the two appendix cases, 1 showed right, 1 left-sided collapse. In the hæmorrhoid case the collapse was on the left side.

The ages were 41, 28, 20, 24, 34, 22 and 25. In only 2 was there any condition noted previous to operation which might have bearing on the development of the collapse. One was a strangulated hernia of 6 hours' duration, which was operated on 1 hour after admission on a cold winter's night. Operation was delayed 1 hour in order that the patient might be warmed. In one other case, a hernia, it was noted that the man was nervous in taking the anæsthetic and his pulse throughout was 120. The anæsthetic used in all was chloroform induction followed by open ether.

The onset of the symptoms was in all cases within the first 24 hours after operation and signs of lung involvement were recognizable within 36 hours after operation.

The symptoms were short rapid respirations, respiratory distress, orthopnœa, pain in affected side, cough, and later expectoration, in two cases blood-stained. The respiratory distress varied considerably in degree,

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and lasted from 2 to 4 days. In 3 of the 7 cases it terminated suddenly: in 1 case at 3 o'clock in the afternoon; in 1 at about 2 o'clock in the morning; and in 1 during the night the man suddenly drew a long breath, was entirely relieved from his pain and distress, felt well, and, on examination the next morning, all or most of the signs to be described had disappeared. In the four other cases the improvement was more gradual and the signs cleared more slowly.

SIGNS

One sign is above all characteristic; the displacement of the heart to the affected side. This was present in all to an unmistakable degree. With this it was noted that the affected side of the chest was smaller, the respiratory movements were markedly less as compared to the sound side, the breathing was suppressed at first, later took on a distant blowing character.

The striking feature was the sudden remarkable change found in the three cases referred to above. In a period of 24 hours between examinations, the heart dullness had returned to the normal, the lungs had become resonant except at the extreme base and the movements were free.

X-rays were taken in 5 cases. In one only a single plate was taken. It shows the density at the left base, the displacement, not as marked as in some, of the heart to the left and the high diaphragm.

Of the second case, two plates were taken, one immediately after the condition was recognized and one on the morning after the sudden clearing of symptoms and signs. This plate (Fig. 1), shows very well the displaced heart, the dense shadow of the right lung, and on the subsequent day the return of the heart and the clearing, not complete, of the lung shadow. In 3 cases daily plates were taken from the time the condition was recognized to the time when the chest had returned to normal. This covered a period of 8 to 12 days.

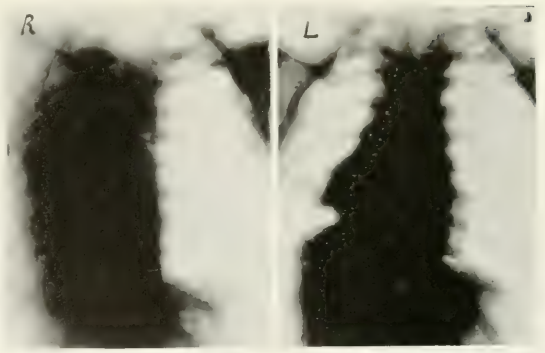

Fig. 1. Roentgenogram on day of onset of symptoms 24 hours after operation. Right side of chest dense. Left clear. Heart displaced completely out of left side of chest and merged in dullness of right side. Right hand picture is reversed. It was taken 12 hours after sudden improvement of symptoms. Right side of chest largely clear. Heart still markedly displaced to the right but is returning to its normal position.

Case 1. Pte. H., age 34, was admitted to Prince of Wales Hospital, July 24, 1919, and operated on July 26 for left inguinal hernia. On the 27th, temperature was 99, pulse 110, repiration 28. During the day respirations became short and jerky, there was some pain in right side. There was an irritating cough. The patient was sitting propped up in bed and in considerable respiratory distress.

Examination. The right side of the chest moved less freely than the left. The cardiac dullness had disappeared, to the left of the sternum, and on the right could not be distinguished from a dull area extending from the right base to the fifth rib in axilla and the fourth rib in front. Over this area the breath sounds were suppressed. The condition was looked on as pneumonia. On the 29th, the whole right side of the chest was dull, the breath sounds distant, blowing. Cardiac dullness was absent to the left of sternum, respiratory distress was considerable, and sputum was blood-stained. July 30, 1919, condition was improved, respiratory movement was better on the right. The upper part of the right chest was resonant and the cardiac dullness had re-appeared to the left of the sternum. There remained a hand's breadth of dullness at right base, extending into axilla. August 10, 1919, the patient had been comfortable for some days, examination of chest was normal except for persistent dullness and diminished breathing at right base. Exploratory needle obtained no fluid. August 29, 1919, discharged, lungs normal.

Case 2. Levesque, V., No. 347507. Admitted to the Prince of Wales Hospital, February 11, 1920, with chronic appendicitis. On admission, the general condition was good. Examination of the lungs was negative; barium meal negative. Operation February 14, 1920; appendix removed. February 15, there was some distress, temperature 99⅗°, pulse 100. February 17, there was a sudden rise of temperature to 102.2°, pulse 120, respirations 30, considerable distress. Examination of the chest showed a wide area of diminished resonance almost of the whole of the left lung with diminished respiratory sounds, which were

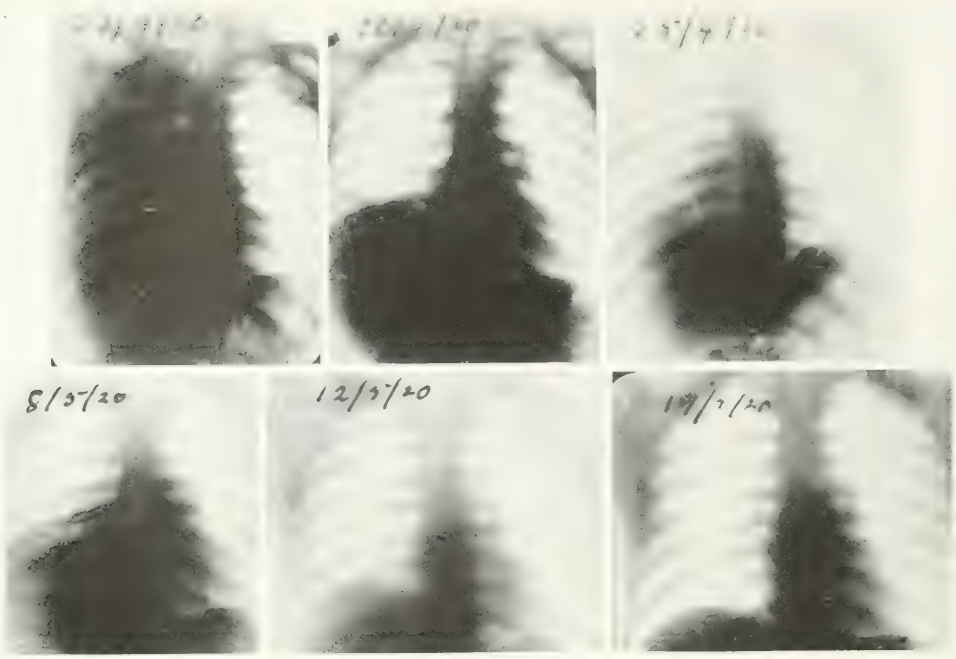

Fig. 2. Series of 6 selected plates taken from daily series from onset of symptoms to return to normal. 23d: Right side dense, heart largely in right side of chest; 25th: right side clearing, heart still to right, diaphragm high; 26th: right side clear, heart about normal, diaphragm high; 8th, 12th, 19th: gradual return to normal.

absent toward the left base, and the apex beat of the heart was drawn well out beyond the nipple line. On February 18, there was a sudden improvement during the afternoon so that the patient expressed himself as feeling quite well. The temperature dropped to 99°, the pulse to 90. He was examined on the following morning, the chest was resonant, there was some cough and expectoration of blood-stained mucus, which rapidly cleared up. February 24, he developed a tonsillitis and after 3 or 4 days an acute œdema of the epiglottis which markedly interfered with his breathing and threatened to make laryngotomy necessary.

On March 8, 1920, he was examined by Dr. Harding who reports: expansion is delayed over the left apex, with bronchovesicular breathing in the right apex; a few râles are also heard over the left apex. The condition was considered suspicious of beginning tuberculosis, and X-ray examination at this time showed mediastinal shadows more extensive on each side than normal and at the base of the heart to the right of aorta a distinct mottling.

Case 3. Pte. F. Caldercoat; admitted November 19, 1919. On admission the patient was suffering from a strangulated right-sided inguinal hernia of 6 hours' duration. He was chilled from a cold trip in the ambulance. Operation one hour later, when it was considered that he was sufficiently warmed. Bowel dark but not gangrenous.

November 20, patient was in great respiratory distress, sitting up in bed, respirations short. He complained of pain in left side. Temperature 101°, respiration 36, pulse 120.

Examination. The left side of the chest was smaller than the right. Movements were restricted. The lower lobe, behind and in the axilla, was dull. The right side of the chest was resonant to the left border of the sternum. The breath sounds over the dull area were suppressed. November 21, condition much as yesterday. X-ray showed lower part of left chest dense, heart displaced toward the affected side, left diaphragm high. Respiratory distress was very great. November 22, about 2 o'clock last night after coughing, he suddenly drew a long breath, called the nurse, and said he now felt quite well. Examination in the morning showed the left side of the chest resonant, the respiratory distress entirely disappeared. The heart dullness was recognized at the right border of the sternum. The cough had greatly lessened. There was no pain. January 8, 1920, discharged, lungs normal.

Case 4. Thivierge, A. Diagnosis: right inguinal hernia. Examination showed small inguinal hernia, descending to the scrotum, easily reduced, and about the size of a walnut. On January 1, 1920, a right inguinal hernia operation was performed, sac was removed, and found to contain no contents. January 14, 1920, temperature rose to $99\frac{3}{5}°$, and there

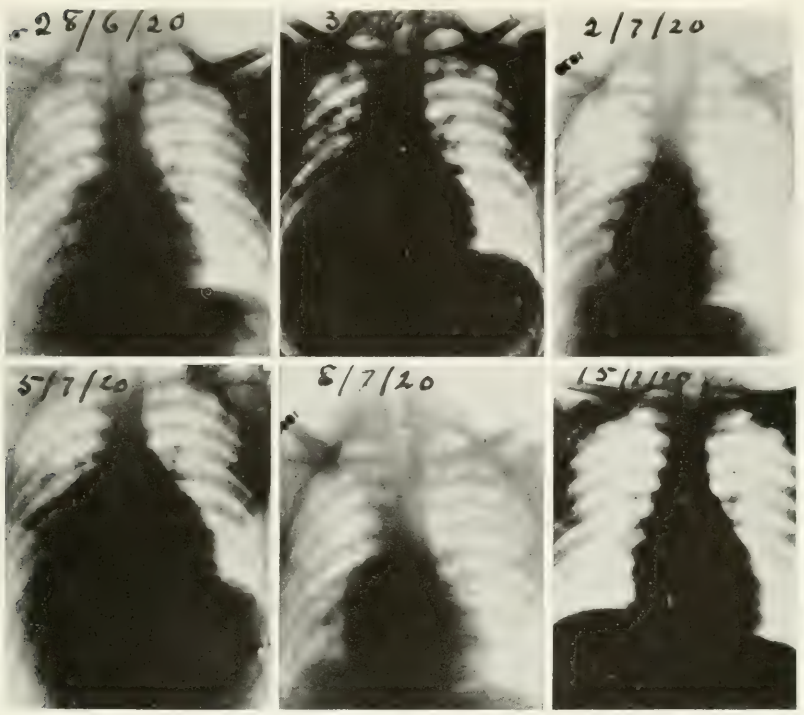

Fig. 3. Series of selected plates over period of 17 days from onset to return to normal. Collapse right side. Right density less in extent than Figure 2, displacement of heart less, diaphragm not so high. Gradual return to normal.

were a few wheezing râles in the right side of the chest. January 15, 1920, temperature was still up, respiration was slightly distressful and he had some cough, with impaired resonance on the right side of the chest. January 16, 1920, temperature 101°, pulse 108, respiration 28. Right side of chest in front as high as the third rib, in axilla as high as fifth rib, was dull. Nothing notable in the anæsthetic; neither distress nor mucus. Right side of chest was markedly dull over lower part, in front, and in axilla, and there was blowing breathing over this area. Heart dullness was absent to left of sternum and was merged in dullness of right side of chest. Breath sounds were distinctly blowing, heart was displaced to right as indicated by the absence of cardiac dullness to left of sternum. The lung was considered to be in a condition of collapse and blowing exercises were instituted. On January 17, 1920, the condition was the same except that retraction between ribs and inspiration and cardiac pulsation could be made out to right of sternum. January 18, 1920, about 3 a.m. after a distressful night he became markedly better. By morning, dullness and blowing breathing had disappeared and heart had returned to its normal situation. Temperature was normal. Examination of chest was now negative. On January 27, 1920, the patient was out of bed. On January 28, 1920, he was transferred for 6 weeks' convalescence to St. Anne's. Other systems were negative.

Two X-rays (Fig. 1) were taken in this case, one on the 16th when the condition was recognized. This shows the marked density of the right lung, the displaced heart. The second on the 18th, the morning following the sudden relief of symptoms. This shows the lessened density of the right lung. The return of the heart toward its normal position.

Case 5. Pte. M. Spino, admitted April 13, 1920, suffering from a recurrent right inguinal hernia. On the day following admission he developed a cough and expectoration. Operation was delayed. Examination of chest by Dr. Harding, April 19, 1920: "Would consider examination of chest negative." Radical operation, April 21, 1920, to cure hernia of right side. No difficulty with anæsthetic, no mucus at the time. April 22, 1920, about 4 p.m., temperature rose to 100°, respiration 36, pulse 112. Examination of chest showed dullness at right base with distant blowing breathing. April 23, 1920, dullness had extended to involve the whole of the right side of the chest. Cardiac dullness was absent to left of sternum. There was no great distress. X-ray picture taken and blowing exercise were instituted. April 24, 1920, condition the same as on

the 23d. On the 25th, the lung showed evidence of clearing rapidly, the whole upper part was resonant, and the heart returning to its place. On May 19, the chest was normal. After the condition was recognized, X-ray plates were taken daily. On the 26th, there was a marked change for the better, the upper part of the lung was becoming clear, the diaphragm was not yet visible, the lower part of the cavity remained dull. This condition persisted and it was only in the plate taken May 8, 1920, that it was recognized that this persistent density of the base was due to a high and fixed diaphragm. An aspirating needle revealed no fluid. May 19, 1920, chest was normal.

Case 6. Admitted June 21, 1920, for subacute appendicitis. Operated upon June 26, 1920. A short, tense, appendix with definitely thickened wall, was removed without difficulty. June 27, 1920, temperature 99°, respiration 30, pulse 88. June 28, 1920, temperature 101°, pulse 120, respiration 40. He complained of pain in right side of chest with cough, a good deal of distress. Right side of chest lagged on respiration, the heart dullness was well inside the left nipple line and extended 1 inch to the right of right sternal margin. There was dullness at right base with diminished breath sounds. It was noted at operation that this patient was unusually nervous in taking anæsthetic, and pulse remained 120 during operation. Daily X-ray examinations were made and blowing exercises instituted. The X-ray pictures showed a moderate density at right base, the heart displaced somewhat to the right side. Subsequent plates illustrate the gradual return to normal.

Case 7. Admitted to Prince of Wales Hospital September 3, 1920, suffering from hæmorrhoids. Operation September 5, 1920. September 6, 1920, complained of some pain in left side. Temperature 100°, respiration 28, slight cough with mucus expectoration, no great respiratory distress. Examination showed that the left side of chest did not move freely. The apex beat of heart was 1 inch outside the nipple line and in the fourth space. The left base was dull as was the left axilla. Breath sounds were suppressed. Right border of heart was at left sternal margin. September 7, 1920, condition about same. September 8, 1920, condition improving, left base clear. Apex beat inside nipple line in normal position. September 16, 1920, X-ray picture showed the density of left base with displaced heart returned to normal.

The explanation of the symptoms, physical signs and the evidence afforded by the X-ray plate as due to a massive collapse of part or the whole of one lung can hardly be called in question, if by massive collapse it is understood that the affected lung is smaller than normal, airless, and dense to the X-rays, and that this density is not due to inflammatory consolidation or the collection of fluid.

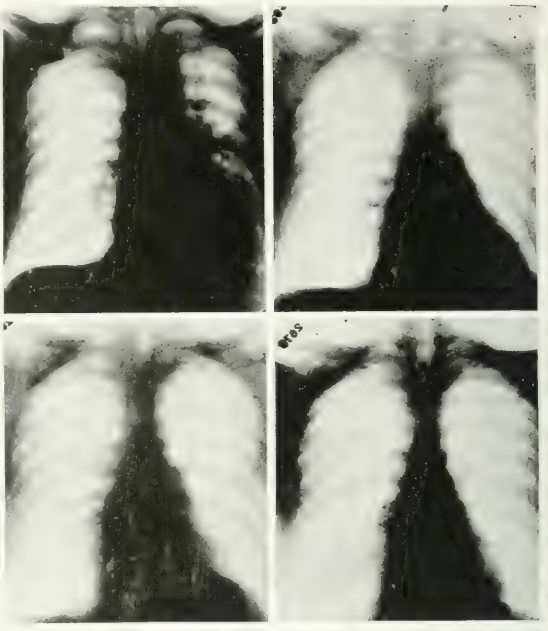

Fig. 4. Series of 4 plates selected from daily roentgenograms over period 11 days. September 5, 1920: left collapse, moderate density, moderate displacement of heart to left, diaphragm not seen on left. September 7, 1920: left chest clear, heart normal, left diaphragm high and under fluoroscope moved synchronously with the right. September 12, 1920: lungs and heart normal, left diaphragm moves freely but is persistently high. September 16, 1920: return to normal.

It is not the intention in presenting these cases to give a review of the literature on the subject, but reference must be made to publications by Pasteur in 1890 and 1914, and to many observations of cases, more particularly among the wounded, as represented by papers by Rose Bradford, Brisco, and others in the last few years.

The symptoms, physical signs, and X-ray appearance are fairly well established, but no satisfactory explanation of the condition has been offered.

In 1890, Pasteur published his first paper dealing primarily with postdiphtheritic paralysis of the diaphragm; in 5 out of 8 post-mortem examinations he found that large areas in the lower lobes were airless, and sank in water. To this condition he applied the term massive collapse, and concluded that paralysis of the diaphragm or other parts of the chest-wall tends to induce loss of function

of the adjacent lung. In a later paper he stated more definitely his belief that paralysis of the diaphragm, lasting over a period of 48 hours, leads to a collapse of the lung.

In 1908 he stated that there were strong grounds for believing that reflex inhibition of the diaphragmatic movements may lead to the same result, and that the postoperative collapse is the result of a reflex arrest of action of one-half of the diaphragm. He reported 16 cases in 2,000 abdominal operations and had observed the same condition after injuries to the chest wall and occasionally after other than abdominal operations.

During the war, large numbers of wounds of the chest were studied, and certain observations made which brought the question of massive collapse of the lung under various conditions actively into discussion. (This aspect of the question has been fully discussed in a paper by Sir John Rose Bradford, published in the *Quarterly Medical Journal*, 1918-1919). He concludes that "the collapse is more readily explained as a result of the immobility and retraction of the chest wall and diaphragm than if regarded as due to bronchial spasm," but in an earlier part of the paper, states that "spasm of the bronchioles would probably be a sufficient explanation of the condition, if we could surmise how it could be brought into action."

J. Charlton Brisco, in April, 1920, *Quarterly Journal of Medicine*, discusses the mechanism of postoperative massive collapse of the lung. He emphasizes the effect of the prolonged supine position and shallow respiration as tending to cause a deflation of the posterior parts of the lower lobes and concluded the phenomena of postoperative massive collapse attacks are produced by the onset of inflammation affecting the pleura, covering the diaphragm in an individual in whom the lower lobes are already deflated. As he points out, this view is not so very different from that held by Pasteur, in that he considers the loss of function of the diaphragm as the cause of the collapse. Elliot suggested the view that the collapse might be due to the blocking of the bronchioles by mucus and the absorption of the air in the alveoli. This is essentially different from the belief of Pasteur, Rose Bradford, or Brisco, in that it points to the primary condition being in the lung and the position assumed by the chest wall as secondary.

The evidence from these cases seems to point in the same direction, namely, that the primary factor in the collapse must be found in some action of the lung itself, rather than a more or less passive result of the state of the surrounding walls.

1. In all, the actual size of the lung was notably smaller than any expiratory state of the chest wall or diaphragm would explain, as was shown by the greatly arched diaphragm, which particularly in Cases 6 and 7 is seen to be higher than normally it is found to be after section of one of the phrenic nerves; by the displacement of the heart and mediastinum toward the affected side, and the lessened range of movement of the chest wall. This latter did not in any of the cases approach immobility, nor was the position assumed even that of extreme expiration.

2. The degree of density to the X-ray was surprising in the absence of consolidation or fluid, and may be taken to some extent as evidence for the airlessness and compactness of the collapsed lung. The sudden relief of symptoms experienced by three of the seven, with the rapid aeration and expansion of the lung as shown by the return of resonance over large areas, the return of the heart to is normal position within a period of at most 6 hours in all three, and 2 hours in one, preclude the probability that the density is due to consolidation or the collection of fluid.

3. In Cases 5 and 7, the photographic plate and the fluoroscopic screen showed the diaphragm to be high and immobile, days after the lung, except for a small portion at the base, had cleared and expanded.

4. The evidence produced by J. Brisco goes to show that lung tissue which is inactive for considerable periods of time, owing to posture and a shallow type of breathing, becomes airless presumably by absorption of the alveolar air.

John Rose Bradford stated in his paper quoted above his belief that an obstruction to the bronchioles would probably be a sufficient cause if we could surmise how it could

be brought about. A mechanism of that kind would probably be an exaggeration of a normal action.

It need hardly be said that the lung contains much elastic tissue; but that the only muscular elements which could affect the problem are the rather scanty circular smooth muscle fibers in the walls of the bronchioles and the rather stronger lobular branches. It must be remembered that these structures are not rigid tubes and are not supported by cartilages. It is known that the obstruction offered by these bronchioles is sufficient to prevent all the air being forced out of the lungs when the chest is opened, and that by absorption of the retained air, the collapsed lung becomes atelectatic in a few hours. There is, therefore, a mechanism, which might be sufficient to produce the condition found in the lung, aided by the presence of mucoid sputum found early in all the cases of this series.

Certain clinical observations in cases of war wounds of the chest and lungs can also be understood on this basis.

It was constantly observed that if seen early, men suffering from wounds of the chest passed through a period of acute distress, characterized by short shallow respirations, often cyanosis and orthopnœa, mental anxiety and other signs indicating lack of adequate oxygenation, and that it was generally wise to set these cases aside for a few hours when frequently without other change in the physical condition their symptoms improved sufficiently to permit of extensive intrathoracic operations. Spasm of the bronchioles as a protective mechanism to stop bleeding was suggested at that time, as an explanation of this period of distress.

It is further known that in some amphibians stimulation of the vagus nerve will cause a contraction of the sac-like lung when the chest wall has been cut away. Recently, experiments by Professor Carlson, of Chicago (and here I speak with great diffidence because the work is as yet unpublished), seem to show that there is a nerve control through the vagus in certain amphibians by which the lung can be made to contract and expand in response to stimulation of this nerve, and that further this reflex arc can be made to act through electrical and mechanical stimulation of peripheral nerves in the nasal passages, the small and large bowel, kidney, bladder, etc.

Such experiments by analogy seem to offer a reasonable explanation by which the abdominal interference may, through a normal vagus control, cause a contraction of the muscular elements in the lung, aided by a subsequent collection of mucus, sufficient to prevent the passage of air beyond the obstruction. Should this be maintained for a few hours the absorption of the alveolar air would produce the condition recognized as collapse. It would also explain the sudden relief of symptoms and the sudden disappearance of signs noted in three of these cases.

THE CAUTERIZATION OF ADHESIONS IN PNEUMOTHORAX TREATMENT OF TUBERCULOSIS

By PROFESSOR H. C. JACOBAEUS, Stockholm, Sweden
From the Medical Ward II of the Serafimerlasarett

At the International Medical Congress in London, in 1913, I gave an account of the first attempt to cauterize string or membrane-like adhesions, which prevent the complete collapse of the lung in the pneumothorax treatment of pulmonary tuberculosis. To a certain degree, the operation embodied a novel principle, inasmuch as it was performed through only two punctures, without a wide opening of the chest wall. Through one of the openings a straight cystoscope, the "thoracoscope," was introduced, by means of which one could get one's bearings in the chest cavity. Through the other, a small metal rod with a platinum wire loop at the end was inserted; this loop may be rendered incandescent by an electric current serving as a cautery. Guided by the thoracoscope the operator locates the adhesions in question and cauterizes them by the glowing wire.

I have published a report of fifteen cases in which I operated. In eight of these a complete collapse was obtained, in one a fairly good collapse without complete cauterization, and in one other a good result, but after such a long time that the effect of the cauterization is uncertain. Since the publication of this report, I have operated in twenty-five additional cases; and Skärgård in the Österås Sanatorium has also performed twenty operations. A report of these cases has not been published, and conclusions in regard to them cannot, therefore, be drawn; but in the majority the results have been particularly good. In June, 1919, at the Surgical Congress in Christiania, Holmboe reported nine operations, several of which resulted very favorably. Holmboe also reported three cases in which operation in his hospital was performed by other surgeons, one of them by me. Saugman has performed the operation in nineteen cases, Sömme in six, and Christoffersen in three. As I have mentioned in a previous publication an analogous method has been attempted by Hervé and Jacobsson, who, guided by the fluoroscope screening, introduced a galvanocautery through a puncture opening, located adhesions, and cauterized. Jacobsson's operation was not successful, but in Hervé's three cases two showed evident improvement.

TECHNIQUE OF OPERATION

Careful practice is required before adhesions can be cauterized with success. No special changes in the original technique have been made recently. It consists of two steps, thoracoscopy and the handling of the cautery, and the performance of the actual operation.

Thoracoscopy affords a clear and sure view of the pleural cavity and the lung, of the course and thickness of adhesions, and of the visible vessels in the adhesions. If accurately performed, no difficulty is experienced in obtaining a surprisingly large field of view, and it is relatively easy to see the existing adhesions and their attachments to the chest wall.

To cauterize adhesions at thoracoscopy the cannula is introduced in the line of the scapula, as high up as possible; about the fifth or the seventh interspace when the adhesions are near the apex, and further down the thoracic wall when they are at the middle or base of the lung. If the adhesions are attached to the anterior wall of the thorax, the cautery may be introduced through an anterior or lateral opening in the chest wall. The adhesions are thereby seen as narrow strings, columns, or broad attachments between the lung and the chest wall. Membrane-like adhesions are distinguished by a bluish transparency, and also by a slight trembling with the movements of the heart. As they are easily cauterized, their recognition is of great practical importance. To beginners it is not, however, always easy to recognize or find the respective adhesions. The thoracoscope should be near the adhe-

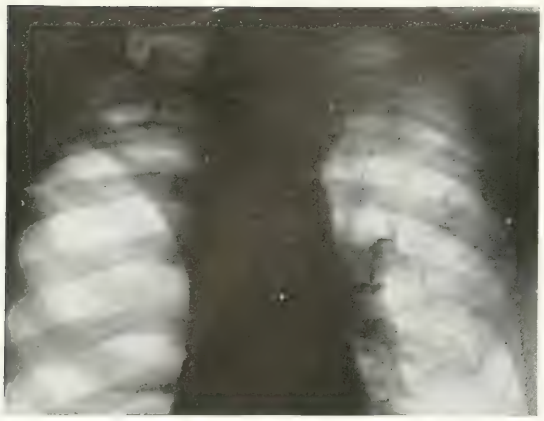

Fig. 1. Case 26.

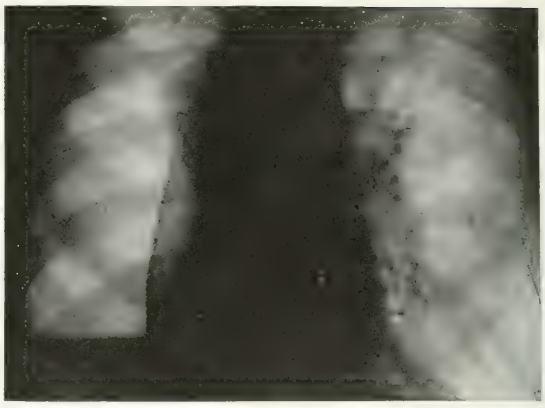

Fig. 2. Case 26.

sions, and the point for introducing the cannula selected accordingly.

The galvanocautery is also introduced through a straight cannula, under local anæsthesia; the point of introduction is very important. By orthodiagraphy, a method introduced by Saugman and which we find very useful, a design is first made of the position of the adhesions on the anterior and posterior chest wall. The thoracoscopy reveals the exact position of the adhesions in the thorax, and the cannula is introduced at a point in the chest wall at which the adhesions in question may be reached with the galvanocautery. Usually a puncture is made in the middle or anterior axillary line from the sixth to the ninth interspace.

Handling the cautery under guidance of the thoracoscope demands practice. The first step is to find the cautery with the thoracoscope, which is sometimes difficult. The cautery is then pushed up to the adhesion to the point where it is to be cauterized; when the contact is made the cauterization may be performed quite easily, if the adhesion is very narrow. In some of these cases it has been my custom to cauterize at several points, in the meantime keeping up a pneumothorax under fairly high pressure. *A priori*, the adhesions ought naturally to be cauterized as near the surface of the pleura as possible, but the painfulness of this procedure frequently renders it impracticable. In most of my cases, however, there was pain, sometimes more and sometimes less. Small strings, as a rule, are burnt off in less than a minute, but the flat surface adhesions sometimes take half an hour; on one occasion I worked for more than 2 hours without completing the cauterization. The consistency of the adhesions affects the ease with which they are cauterized. The small strings may be very firm, and great pressure is needed to sever them, while in the membrane-like adhesions, for example, the tissue is often very loose and easy to cauterize.

Hæmorrhage during the cauterization may be considered one of the most dangerous complications. I myself have encountered only one severe hæmorrhage, which took place after the cauterization of a very thin adhesion; blood dripped from the burnt-off stump to the amount of between one and two hundred cubic centimeters. The hæmorrhage stopped spontaneously. I believe that in most cases the hæmorrhage is due to the use of too hot a galvanocautery. In my recent operations I have used such a weak glow that 5 or 10 seconds was needed after the current had passed before the instrument was brought to a red-hot glow. A white glow must not be used. However, should a hæmorrhage occur which cannot be checked, most of the danger may be avoided by the production of a pressure as high as possible in the pleural cavity, either by insufflation of air, or perhaps still better, by sterile salt solution. Only six of about one hundred patients operated on by

this method have had hæmorrhages of any severity; and in but one instance was there any real danger. The danger cannot, therefore, be regarded as very great, though the possibility of hæmorrhages attended with a certain degree of danger is of course always to be considered.

CASUISTICS

The histories of the entire series of cases cannot be given in detail, and I have therefore selected for discussion three of the important cases in which extensive cauterization was effected, and thereby complete collapse of the lung obtained. Detailed studies of other cases may be found in my contemporaneous publication in *Acta Chirurgica*.

Case 26. Captain M. K., born in 1866, was admitted to Veilefjord Sanatorium with pulmonary tuberculosis, which had commenced in 1916. Pneumothorax had been established April 4, 1918. Complete collapse was not obtained, the lung being attached laterally upward and outward through broad adhesions.

The first operation was performed in Veilefjord Sanatorium, September 16, 1918. On thoracoscopy the pleura was seen to be slightly thickened, with fine costal spaces and interstices. The lower part of the lung was well compressed; the upper lobe adherent laterally outward, upward, and a little forward by a broad adhesion which ended downward in a rather broad thick base. The continuation of the adhesion upward and backward could not be seen, and it could not be determined how far up into the pleural cavity it extended. On applying the galvanocautery it was found to be very difficult to reach the narrowest portion of the adhesion, because of the narrowness of the interspace. The lower, thicker portion of the adhesion was not very firm, and was burned through readily enough, but the farther one went the greater became the difficulties, the galvanocautery itself being too soft and a little bent. A change of cautery produced some improvement, but when two lamps had been burnt out and it was impossible to proceed further, the operation had to be discontinued without complete severance of the adhesion. Altogether the lung should have been loosened over an area at least 3 or 4 centimeters in length and 2 or 3 centimeters in width, and collapsed so that the distance between the most remote cauterized surfaces was 3 or 4 centimeters. At the close of the operation, which lasted for more than 2 hours, a slight hæmorrhage of the edges and surface was noticed, and the patient was tired, though not in bad shape. The next day the temperature was 39.4 C., the following 37.5 C., and later normal, there was no exudate.

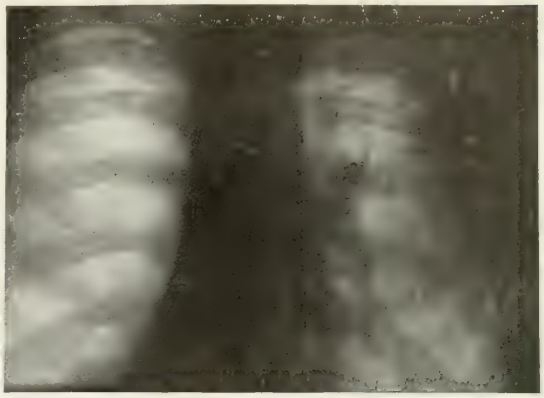

Fig. 3. Case 26.

The patient, who was not quite sputum-free, but still had an adhesion laterally, which prevented the cavity from collapsing, was admitted to Serafimerlasarett on March 20, 1919. X-ray examination the following day showed an almost complete pneumothorax on the left side, a nearly complete collapse of the lung, and a displacement of the heart to the right. An adhesion of the second rib 1 or 2 centimeters broad kept the cavity extended.

March 22 the second operation was performed. Upon thoracoscopy upward and laterally, a white, shining sinewy adhesion, the thickness of a finger, was seen running to the chest wall about level with the third rib. The cauterization of the thinnest portion of this adhesion was rather easy, with no hæmorrhage and only moderate pain. The following day the patient developed moderate superficial emphysema, and the temperature rose to between 38 C. and 39 C. Subsequently a serous exudate of moderate amount developed, which on culture showed no growth in the blood agar. X-ray examination on the 26th showed that the lung had become considerably inflated since the last picture, and had shrunk together to a somewhat conical shape; and that the adhesion was cauterized far laterally. In the lower portion of the pleura a layer of exudate several cubic centimeters deep had developed.

Within a fortnight the lung was completely collapsed, but the temperature did not become normal for 4 or 5 weeks. The sputum gradually became less in amount, and when the patient was discharged, May 11, 1919, it was only about 10 to 20 cubic centimeters and was negative for tubercle bacilli. X-ray examination April 24, 1919, showed that the left lung was in complete collapse, and that the free surface of the fluid had sunk to the sixth costal cartilage. The mediastinum was visibly displaced by respiration, and there was no sputum. According to the latest report, in October, 1919, the patient's general condition was excellent, and he was entirely sputum-free.

Case 27. Mrs. A. T., born in 1887, was found in the mid-summer of 1912 to have pulmonary

Fig. 4. Case 27.

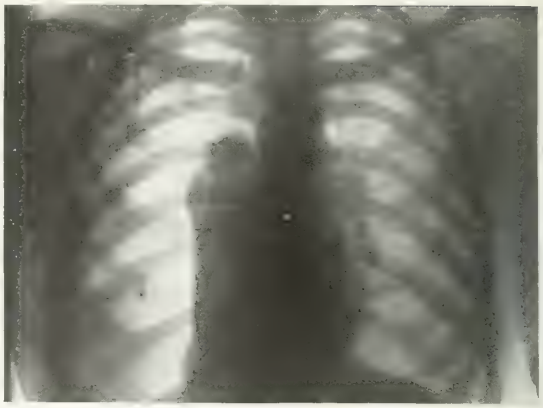

Fig. 5. Case 27.

tuberculosis. Following a five-months' stay at a sanatorium, she was quite well until Christmas, 1917, when she had a recurrence, and was admitted to Veilefjord on September 10, 1918. We found an extensive tuberculous process of the left lobe and rather large quantities of purulent sputum containing tubercle bacilli. Pneumothorax was established September 28. X-ray examination revealed a partly compressed lung, with several string-like adhesions upward and outward, and also a very thick adhesion from the lower lobe straight outward to the chest wall. In the upper portion of the lung, which was only partly compressed, smaller cavities were seen, which were not collapsed.

Operation was performed January 13, 1919. On thoracoscopy, four string-like adhesions were seen to be keeping the lung expanded in different directions upward in the posterior axillary line in the seventh or eighth interspace. They ranged in diameter from the thickness of a string to that of a little finger. Downward, anteriorly, an adhesion of about the thickness of a thumb was found. The upper adhesions were readily burned off, but the thickest, lower one was difficult to get at with the galvanocautery, as it had to be twisted until it came to lie parallel with the thoracoscope. It was three-cornered in shape, with offshoots in three directions, and had to be burned in several stages, with an unusually hot cautery. It was rather soft, however, and was finally removed without much trouble. The lung at once collapsed into the pleural cavity. In spite of the many and extensive cauterizations which were required, there was only moderate pain and no hæmorrhage. There was no reaction to speak of; the next day the patient had a temperature of 38° C. and no exudate.

On X-ray examination January 15, 1919, the lung seemed to be completely collapsed. The lateral outline had approached the midline about 3 centimeters. The broad adhesion which had been cauterized at the base of the lung, and the peripheral burned-off stump at the lateral aspect could be seen in part. January 25 the patient was discharged for policlinic treatment. Subsequently a complete collapse of the lung was obtained; there was no sputum, and the patient was otherwise symptom-free.

Case 28. L. M. E., born in 1892, had always suffered from bronchitis and asthma. On May 11, 1917, he had a hæmorrhage. A tuberculosis involving the right lobe, with multiple cavities and smaller changes in the left lobe, was found. Pneumothorax was established April 19, 1918; after a few months of treatment he was free of bacilli, but the following September they again appeared, and remained up to the time of the operation. Repeated X-ray examinations showed a broad adhesion, which kept the lung adherent laterally to the chest wall. At first the lung appeared quite compact, but later a cavity was discerned just opposite the attachment of the lung to the chest wall.

Operation was performed May 21, 1919. On thoracoscopy the adhesion was seen like a thick, greyish white wall passing over on to the lung, so that it was not possible to see where the lung commenced. It was of much the same color throughout, and perfectly opaque. Several angular offshoots were seen, a smaller one downward, a little larger one backward, and a thinner one upward, the upper limit of which could not be made out. The limit of the adhesion forward also could not be seen, so that the prospects for a cauterization were very small to begin with. A small dent, however, was first made on the adhesion downward, which was found to be of a very fibrous character, and burned slowly. Then a trial was made with the outshoot backward, a little within the edge, where the galvanocautery passed entirely through the membrane, which was not more than 3 or 4 centimeters in breadth. From this hole the adhesion was burned alternately upward and downward; upward it became progressively thinner, but downward it gradually became thicker than the length of the cautery. It was rather soft, however, and the wire was first put to a very dull

Fig. 6. Case 28.

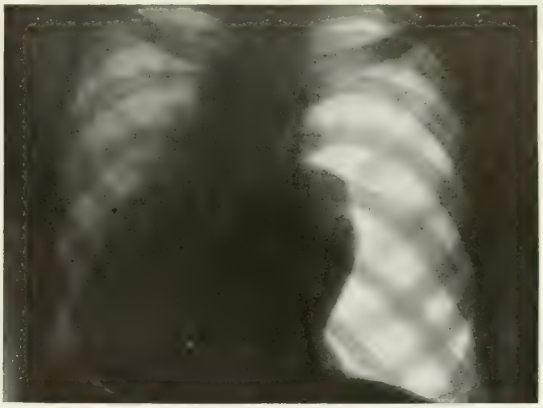

Fig. 7. Case 29.

glow and then bit after bit of the adhesion burned off. The greatest difficulty was encountered in the field of view farthest to the front. Finally the upper bridle, the end of which could not be seen, was attacked, after which the whole lung collapsed 5 or 6 millimeters. There was no hæmorrhage and very little pain. The orientation was rather difficult, especially in deciding where the adhesion was attached to the lung. At this point the pleura was a greyish white, thickened with hæmorrhages here and there. The length of the adhesion in the cauterized surface might have been about 15 centimeters, and stretched upward, downward, and forward in the form of a bow. The greater part of the lung was attached to the anterior chest wall. No real discomfort followed the operation. After a few days, without any apparent cause, the temperature began to rise, and for a fortnight remained between 38° and 39° C. There was no exudate, and nothing audible from the other lung. On X-ray examination it was found that the lung was well compressed and the cavities no longer visible. The temperature became normal rather abruptly, the sputum quite ceased, and the condition was very encouraging until the spring of 1920, when the process commenced in the other lung, probably induced by unfavorable surroundings.

This is one of the most extensive operations of the kind that I have performed, and contains details of great interest. The adhesion had the shape of a U, with the convex bow in a backward and downward direction. On thoracoscopy, only the convex surface of the adhesion could be seen. The impression of a compact surface adhesion was therefore given, which it would not be possible to cut through by the method under discussion. When the cauterization was commenced experimentally, however, it was found that the adhesion was membrane-like, and that an especially favorable case for cauterization was at hand. In respect to function, also, it became a particularly successful case, with complete collapse of the lung and no sputum nor bacilli. The turn for the worse after April, 1920, had its cause in entirely external conditions.

One complication that may succeed this operation is a skin emphysema, originating at the puncture opening of the pleura. If the patient has an irritating and persistent cough, the emphysema may become extensive, reaching from the iliac crest to the neck, and causing trouble in swallowing and local soreness over the whole of the affected area; it is often attended by a slight rise in temperature, although I am not certain that this is caused by the emphysema. In from 3 to 5 days the skin emphysema is for the most part absorbed; and this complication does not affect the ultimate result of the operation.

The pleuritic exudates are of very different significance. The cases on which I operated may be classified as follows:

1. Cases without a trace of exudate, 19.
2. Cases in which the exudate did not reach above the pleural cupola and disappeared in from one to two weeks, 12.
3. Cases with massive exudate which persisted for several weeks and was attended by a fever of corresponding duration, 3.
4. Cases with exudate which developed into a chronic empyema, 4.
5. Cases in which an empyema due to mixed infection of tubercle and pyogenic organisms immediately appeared, none.

6. Cases in which at first there was either no exudate or only a small amount for a short time, but in which after one month or more an exudate of long standing or an empyema developed, 2.

In the first group of nineteen cases, nearly 50 per cent, most of the patients had fairly extensive adhesions; among them was a case in which I performed the most extensive cauterization.

The second group includes cases in which only a very small amount of exudate appeared for a relatively short time, usually attended with a slight rise in temperature. The question as to whether or not these cases of mild pleurisy are of tuberculous origin has not yet been decided; if not tuberculous they are probably of a purely thermal type. In one case I made a guinea-pig inoculation with a negative result; this would seem to support my opinion that these exudates of a duration of two weeks or less, accompanied by only a slight rise in temperature, are a result of the thermal irritation which is caused by the actual cauterization. Further study on this point will be of interest. This type of pleurisy has on the whole no influence on the clinical course of the disease. In about 75 per cent of the cases, therefore, no complications have been found following operation which had any permanently harmful effect.

In the third group, comprising three cases, a pleurisy with effusion with high fever of from four to six weeks' duration developed, which had a marked influence on the general condition of the patient. Microscopical examination of the exudate generally presented a lymphocytic picture. Without doubt the condition was tuberculous. I believe that some small tuberculous focus had been opened at the cauterization, and an infection of the pleural cavity had taken place, with the above mentioned result. The effect, although temporary, is without doubt very injurious, producing an obvious lowering of the general vitality over a considerable length of time.

The fourth group comprises four cases. Immediately after the operation a severe pleurisy with effusion developed, with a high and obstinate fever. During the first weeks or months the exudate was of a serous nature. It then became more turbid, and finally developed into a typical tuberculous empyema. Without doubt this severe complication was caused by the operation, the tuberculous foci in the adhesions or the smaller cavities in the lung having probably been opened during the cauterization. Three of these patients died within the next year or two. In one case, it is true, the immediate cause of death was an incidental angina, but the patient's general condition was so gravely impaired by the tuberculous empyema that his death must be principally attributed to it. In the fourth case the empyema lasted for over a year, but the patient eventually recovered. In these four cases, therefore, it cannot be denied that the operation was followed by the most serious developments.

In the fifth group I have considered the possibility of an immediate mixed infection of tubercle and pyogenic organisms developing. I have included this as a possible complication, by reason of the fact that just such a complication has taken place in a case in which thoracotomy was performed with a direct cutting off of the adhesions (Saugman and Rovsing). In none of my cases, however, has it ever occurred, nor have I heard of its occurrence in any cases in which others have operated.

In the sixth group of two cases, the condition immediately after the operation was good. In one case there was no immediate exudate, and for six weeks everything looked favorable. A very severe pleurisy then developed without warning, which shortly went on to a tuberculous empyema. In the other case there was a small amount of exudate in the operative sinus, which, however, disappeared within a fortnight. Three months later an exudate again appeared, which developed into an empyema. These two cases may be compared with those in the first and second groups.

To sum up, it is found that during the actual operation, it is the hæmorrhage that one has most to fear. But out of about one hundred cases, there is only one, reported by Dahlstedt, in which a really dangerous hæmorrhage occurred. Of the forty cases to which I have particularly referred, a

hæmorrhage of between 100 and 200 cubic centimeters has occurred only once. In my opinion, therefore, if the directions which I have given are followed, danger of hæmorrhage is small.

With the pleuritic exudates following operation, however, the case is different. These appeared in about 50 per cent of the cases. They are of two kinds: one comparatively unimportant, which is probably developed by thermal irritation, and disappears in from one to two weeks; and one more malignant, which in some cases developed into a tuberculous empyema, often of serious character, and which in three of these cases resulted fatally after a shorter or longer period of time. This is the most serious complication that has appeared, up to the present, and I have not succeeded in finding any remedy for it. From the description given above, it will be seen under what conditions it is most frequently met with. According to this short summary, it has so far caused about an 8 per cent mortality.

I do not know of any other complication, such as air embolism, for instance, which results from this operation, either from my own experience, or from that of others.

The adhesions were located (1) at the apex, (2) laterally, and (3) at the diaphragm. The greater number, thirty-four cases, belong to the second group in which the lung is attached to the lateral chest wall, by narrow or broad adhesions; especially laterally upward, tending toward the axilla. They are most frequently found from the second to the fourth interspaces; and are quite readily accessible to the operator. Under the apical adhesions, I have arbitrarily included only cases in which the adhesions have been localized above the second rib. Cases in which the adhesions have begun in the lateral region and continued up to the apex have been included with the lateral adhesions, as has also one case in which two coarse adhesions were found laterally, and a small string-like one of less importance at the cupola of the pleura.

TABLE I.—TABULATED CASES

	Cases	Cauterization complete or sufficient for compression of the lung	Incomplete cauterization
Apical adhesions.....	3	2	1
Lateral adhesions....	34	25	9
Diaphragm adhesions	3	3	..
	40	30	10

In two of three cases of apical adhesions, it was possible to cauterize sufficiently to bring about a satisfactory compression of the lung. In none of the cases was the cauterization complete, because of the fact that the attachments continued on the mediastinal side. These apical adhesions are often short, with cavities just beneath, so that one generally has to move with care. The technique is rather difficult, and the operation is painful.

In three cases of adhesions to the diaphragm the operation was carried out and the string-like adhesions were removed. In all of these cases the upper portion of the lung was adherent to the chest wall to such an extent that cauterization upward was out of the question. The lung was pressed against the cupola, and thus collapsed by loosening the adhesions at the diaphragm and continuing the compression under high pressure. In two of these cases this procedure was not entirely successful; in the third, cauterization resulted in a cessation of sputum for the next few months. This method of effecting a more indirect collapse of the lung is probably successful only in exceptional cases. It must be added, with regard to the two unsuccessful cases, that in one a severe serous pleurisy, and in the other an empyema developed. Lastly, the technique is rather difficult, because of the fact that during respiration the adhesions are in constant movement, and therefore the actual cauterization, if it can not be done by one contact, has to be performed in several short stages, during which the patient must hold his breath. It is also very difficult to judge beforehand whether the compression obtained by removing such adhesions can be of any real value.

In twenty-five of the remaining group of thirty-four cases, the cauterization of the adhesions was sufficient for compression of the lung, if not complete. Complete detachment was effected in twenty cases, and in all of these a complete collapse of the lung was later obtained. In the remaining five cases the lung was attached to the cupola itself, and the adhesions were too short to be cauterized.

In three of the nine cases in which no effect was obtained, trial operations were performed,

at a time when the technique was not well developed. In one case, a fairly extensive cauterization was performed on a surface adhesion, which was situated on the anterior chest wall. It was difficult to get at it, and also to judge the result afterward. In all cases a complete pneumothorax was obtained; but it is impossible to decide to what extent the cauterization effected this. In the other cases a somewhat better compression was certainly obtained after the cauterization; but no definite influence, either good or bad, can be traced to this.

SUMMARY

In summarizing the data in the forty cases in which operation was performed, it is seen that in thirty the purpose of the operation was attained. Complete or sufficient compression of the lung was obtained in twenty-seven of thirty-seven cases of adhesions to the apex and the lateral chest wall. The aim of operation was attained in all three cases of adhesion to the diaphragm; but in only one was a corresponding practical and valuable result gained. From these thirty cases four must be deducted in which operation was followed by a complicating serous pleurisy or tuberculous empyema, with serious consequences to the patients. In twenty-six of forty cases, therefore, a satisfactory pneumothorax was obtained, and the operation was of genuine benefit. The early convalescence was favorable in all cases except in the five mentioned; later on, however, it was highly variable, depending on other factors, especially on the condition of the other lung. I have made no résumé of the lasting results with regard to the pneumothorax treatment in these cases. It would naturally be of interest to see whether the lasting result would be better in these cases than in pneumothorax cases in which this operation was not performed, but as yet there are not sufficient statistics for such a comparison. The statistics of the immediate effect of the operation which are presented above, however, should be sufficient to justify the operation as an adjunct in the pneumothorax treatment of pulmonary tuberculosis.

The indications and contra-indications for the operation, as far as it is possible to give them, can be found in the description of the different cases. The string- and membrane-like adhesions are the best subjects for the operation. Surface adhesions also are adapted for cauterization to a certain extent, but nothing can be said with certainty in advance as to the prospect of success. In four cases I have cauterized surface adhesions in two sittings; and it is quite possible that the use of the method can be extended in this way.

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FOCAL INFECTIONS WITH METASTATIC MANIFESTATIONS[1]

With Special Reference to Gonorrhœal Arthritis

By JOHN H. CUNNINGHAM, M.D., F.A.C.S., Boston

WHAT I have to say is in connection with a certain feature of the general subject of focal infections resulting in metastatic manifestations, which general subject, particularly the arthritic disturbances, has been so much under consideration in recent times.

The conception that a focus of infection may be the cause of so-called rheumatic manifestations has become well established; the teeth and tonsils attracting the most attention as the sites of such foci. The truth is that the profession, in general, think too little of any other possible nidus of infection and too seldom include, as they should, other possible areas of infection in the differential diagnosis, so that without a proper differential diagnosis, teeth, tonsils, or both, are too often sacrificed without benefit to the patient.

Admitting the teeth and tonsils to be the most frequent sites of the foci of infection from which the metastatic arthritic manifestations take place, definite pathology may be wanting in these organs and one must not fail to include in the differential diagnosis, infections in the sinuses of the head and organs of the digestive, urinary, and genital systems. Particularly is this true of infection in the genital tract, and foci of infection in the deep genital organs, the prostate and seminal vesicles, producing arthritis and other metastatic manifestations, must rank in frequency of occurrence with the teeth and tonsils.

In this connection I wish to point out that the first conception of curing arthritis by the surgical removal of foci of infection was brought forward by Dr. Eugene Fuller, of New York, in a publication in the *Annals of Surgery*, June 1905, entitled "The Relation of Gonorrhœal Rheumatism to Seminal Vesiculitis and its cure by Seminal Vesiculotomy." What Dr. Fuller pointed out in regard to genital foci of infection has not been generally appreciated and today foci of infection in other organs producing metastatic arthritis are more commonly thought of and the genital foci as the cause of arthritis are usually the least thought of in this connection. I wish to emphasize the importance of including such infections in the differential diagnosis for I have seen too many patients who have lost their teeth and tonsils, but not their arthritis, because the foci were in the seminal vesicles and prostate.

It is my desire, at this time, to mention briefly the methods of establishing the presence of such foci of infection and the manner of dealing with them, for, with the exception of a very few American surgeons, the field has been untouched, and because each surgeon who has mastered the methods of diagnosis and operation have become enthusiastic about the results.

Diagnosis. It is most usual that a urethral discharge co-exists with arthritic manifestations due to a gonorrhœal or other type of infection in the prostate and seminal vesicles, making the explanation of the arthritis most probably due to infection of these organs, yet the urethral discharge is not infrequently so slight or of so long standing that unless a careful history and examination is made the fact of a previous urethral infection is not illicited in the history, and the general examination fails to be directed to this possible cause of the arthritis. Upon the recognition of foci of infection in the seminal vesicles and prostate and the removal of these foci by surgical methods, the condition commonly known as gonorrhœal rheumatism, and generally admitted to be a most unsatisfactory malady to treat by palliative measures, is, by a properly performed operation, changed into one of the most brilliant surgical triumphs.

I have observed many cases in which a chronic prostatitis and vesiculitis has persisted, with or without remissions of urethral discharge, and the onset of arthritis manifestations had no possible explanation except

[1] Read before the Clinical Congress of American College of Surgeons, Montreal, October, 1920.

from the foci of infection in the genital tract. Moreover, we have observed arthritic disturbances from foci of infection in the vesicles and prostate, when urethral infection has been denied, urethral discharge absent, and no gonococci can be demonstrated in the secretions expressed from these organs. Such foci located in the deep genital structures are, I believe, due to other pyogenic organisms than the gonococcus. In this connection it may be remembered that Billings has pointed out the relationship of chronic staphylococcus infection of the seminal vesicles and arthritis deformans.

The method of establishing the presence of foci of infection in the prostate and seminal vesicles, and it has been definitely demonstrated that if the infection exists in the seminal vesicles that it usually co-exists in the prostate, the history must disclose an existing or previously existing urethral discharge, and the material expressed from the prostate and seminal vesicles, by rectal massage, and collected in a clean dish must show, by microscopical examination, clumped pus and desquamated cells from the prostate or vesicles, or both. The absence of organisms does not enter into the decision, and the demonstration of the gonococcus is not important. More frequently other organisms are demonstrated, and when the gonococcus is present it is not usually found within the pus cells unless the infection is a recent or a particularly active one.

The pathological features, by rectal examination, are in the form of a boggy enlargement of the prostate, with or without nodules, or enlargement of the seminal vesicles with thickening of their walls, or a perivesiculitis; yet it is the microscopic examination of the secretion expressed from these organs that gives the true evidence, just as the examination of the urine does with a palpable kidney. The diagnosis, therefore, depends upon the history of urethral discharge, the demonstration of pathological changes in the prostate and vesicles by rectal palpation and above all the presence of clumped pus in the microscopical examination of the secretions expressed from these organs. A positive complement fixation test for gonorrhœa is valuable corroborative evidence in the diagnosis and should always be employed in determining whether or not an arthritic condition is gonorrhœal in origin.

Treatment. With the elimination of foci of infection in other structures and the foci having been demonstrated as in the deep genital organs, the metastatic manifestations may be cured by a surgical removal of these foci. Nonoperative measures, such as prostatic and vesicle massage, vaccines and other palliative treatment fail to produce a cure in about 90 per cent of patients affected with severe gonorrhœal arthritis. Even in those patients where palliative treatment produces improvement, the improvement is slow, recurrences are prone to occur, and the individual must be considered infectious. Palliative treatment should, however, be given a fair trial at the onset of the arthritic manifestation; time may be lost by so doing, but improvement may be satisfactory, and if not, the patient is more desirous for the operation.

The operation of removing the foci of infection makes the patient sterile, but not impotent. What percentage of individuals with seminal vesiculitis and prostatitis are rendered sterile by such lesions, if left untouched by operation, is problematical, probably a high percentage. Certainly these patients with gonorrhœal arthritis think little of matrimonial ventures, many are chronic invalids, and when given the choice of being made useful individuals at the loss of reproduction, there is rarely any hesitation in choosing the operation.

There is no operation performed for a chronic condition, with which I am familiar, that gives more striking results. With the removal of the foci of infection, the pain has disappeared from the affected parts, often at the time of the ether recovery, and large swollen joints have become normal in appearance, or nearly so, within 24 or 48 hours following operation. Peri-arthritic swellings disappear much more rapidly than do those which are intra-articular, and when destruction in cartilage and changes in bone have taken place, a considerable period of time and appropriate accessory treatment are necessary to repair such defects. A discussion of the

various features entering into the ultimate results following operation in 128 of my cases has been published in the *Journal of Urology*, August 1919.

The *operation* should be directed to both the prostate and vesicles for abundant pathological material has shown that the foci coexist in both organs as a rule, and if the foci are attacked in but one a cure is not so frequently complete, and nothing short of the complete removal of the foci will assure a cure.

In the operative procedure the vesicles must be thoroughly drained, and as they are complicated tubular structures with multiple diverticula from which infection may find no avenue of escape, every portion must be opened; and it is probably safer, on this account, to extirpate them. The prostate, however, need only be thoroughly opened by multiple incisions and it is not necessary to enucleate the lobes.

The technique of operation is essentially that employed by Squier and Young and differs entirely from that advocated by Fuller. A complete report of the technique has been published in Surgery, Gynecology and Obstetrics, April, 1917.

The steps of the operation are those of the perineal dissecting operation for prostatectomy, except that the dissection is carried above the prostate on to the posterior surface of the bladder through an incision in the fascia of Denonvilliers. In order to bring the posterior surface of the bladder into view, the rectum must be held downward by a retractor and the prostate drawn downward and rotated upward. This latter feature is accomplished either by a double tenaculum inserted into the superior border of the prostate or by stay sutures as employed by Squier, or a tractor passed into the bladder as practised by Young. Any of these three methods draws the prostate downward and rotates it forward so that the vesicle area can be brought into view. The fascia of Denonvilliers may be incised along the superior border of the prostate and pushed backward exposing the vesicles and vas deferens on either side, or an incision may be made over each vesicle in turn. The transverse division of the fascia of Denonvilliers gives the broader exposure. After the vesicles are exposed they may be still further drawn downward by traction on the vas deferens. With abruptly curved long scissors the vesicle may be separated from the posterior wall of the bladder and removed, except in rare instances where the inflammatory reaction has resulted in excessive scar tissue binding the vesicles to the bladder wall. In such instances the posterior surface of the vesicles should be cut away and the whole interior destroyed by a thorough curetting with a carbolic acid swab followed by alcohol, the essential feature being to destroy every section of the vesicle either by removing the entire organ or destroying its entire cavity. Multiple incision sometimes fails in this purpose.

The ampulla of the vas deferens should always be opened as it has been proved that infection may be expected to exist therein when the vesicles are involved.

There is little hæmorrhage in the operation unless the vessels located just outside and at the top of each seminal vesicle are opened. If this occurs, as it rarely does, the application of a heavy clamp during the succeeding steps of the operation are sufficient to control it; and to tie them is most difficult because of the depth of the wound.

After dealing with the vesicles the capsule of the prostate should be incised over each lateral lobe and pushed backward so that the prostatic tissue is exposed. The prostatic tissue should be deeply and freely incised by multiple incisions as sections removed at the time of operation have shown that inflammation usually co-exists in the prostatic tissue when the vesicles are involved, and drainage of the infected tissue is desirable. The bleeding which may result from the cut edge of the prostatic capsule may be controlled by crushing with a heavy clamp or a catgut suture. It is seldom active and rarely requires attention.

Drainage of the vesicle area is made either by catching a small rubber tube, by a fine catgut suture, to the wall of the vas as high as possible on either side, or if oozing is considerable, each vesicle area may be packed by an iodoform gauze wick. Either form of drain-

age is sufficient to drain the prostatic area by which it passed.

The repair is made by uniting the divided median tendon and rectal urethralis muscle by single mattress suture of catgut and the external wound closed by interrupted silkworm-gut sutures so that the drainage tubes or wicks protrude from either angle of the wound.

If the urethra has been accidentally opened a self retaining catheter should be placed into the bladder and constant drainage established. The rectum should be carefully examined and if opened, immediately repaired.

In order to obliterate the large cavity made by separating the rectum from the prostate and bladder, a rectal plug about 5 inches long, made by covering a rubber tube with iodoform gauze, should be placed in the rectum. This replaces the rectum in its normal position, obliterates the cavity, arrests oozing by pressure, and allows the escape of gas from the bowel.

The after-care consists in keeping the bowels confined by opium and a light diet is given for 4 days. On the fifth day the rectal plug is removed, an oil enema of 2 ounces given, and the bowels emptied by a saline. The drainage tubes are removed the following day. The wound is usually healed within 2 weeks.

CONCLUSIONS

I wish to urge that the possibility of foci of infection in the deep genital structures be included in the differential diagnosis of infectious arthritis, and I feel certain that those who recognize such lesions and deal with them surgically will be enthusiastic about the results.

PRESENT STATUS OF THE TREATMENT OF OPERABLE CANCER OF THE CERVIX[1]

By WILLIAM P. GRAVES, M.D., F.A.C.S., Boston

IN reading a paper on the present status of the treatment of operable cancer of the cervix uteri I shall necessarily repeat in substance many of the views that I expressed in an article with a similar title read at the last meeting of the American Gynecological Society in June of this year.

It is only a very few years since the Wertheim operation constituted the most absorbing topic in gynecology. Stimulated by the imposing figures that emanated from the foreign, especially the German, clinics, American surgeons emulated each other in reporting their cases. The operation proved to be a difficult one. Many operators, either through inadequate technical experience, or as the result of unwise choice in the selection of operable cases, encountered an appalling primary mortality or distressing sequelæ, following injuries to the hollow organs of the pelvis. As a consequence the popularity of the extended operation began to wane, and statistical reports became more infrequent. On the advent of radium, with its spectacular curative properties, surgeons welcomed an agent which gave promise of relieving them of the laborious responsibilities entailed by the Wertheim operation and in some clinics which were fortunate enough to possess radium in sufficient quantity, the surgical treatment of cervical cancer has been almost entirely abandoned. A certain number of operators, however, have continued to endeavor to perfect themselves in the difficult technique of the operation and have been rewarded by an increasing improvement in their results as indicated by sporadic reports in the literature. They have comprised partly those who were unable to avail themselves of the expensive radium treatment, and partly those who though possessing radium have been unconvinced of its ultimate curative power in uterine cancer. Of these two types of surgeons, Dr. Reuben Peterson, and Dr. Howard C. Taylor may be cited as notable examples. In January, 1920, Dr.

[1] Read before the Clinical Congress of American College of Surgeons, Montreal, October, 1920.

Farrar Cobb published in the *Boston Medical and Surgical Journal* a statistical report of 60 operations on cervical cancer, the results of which excelled in some particulars any that had previously been recorded. Dr. Cobb's paper created a sensation, and in some quarters was received with astonishment by those who, from their own experience or from the testimony of others, had come to regard the surgical treatment of cervical cancer as impracticable. To those, however, who still had faith in the operation as the treatment of choice for operable cases, the paper was a message of encouragement.

On the other hand recent reports from the more important radium centers have been increasingly promising. Undoubted cures have been recorded, and the more enthusiastic adherents of this form of treatment are already openly proclaiming the death-knell of the operation and advocating the application of radium in all cases. Such an outcome is made possible by the fact that the unavailability and expensiveness of radium, which until recently made it almost prohibitive in most localities, is being overcome. Judging from its present rapid extraction and distribution in private and public institutions throughout the country, its benefits will soon be accessible to all.

The immense value of radium as a palliative agent in the relief of inoperable cancer of the cervix was immediately established when it was first employed. The problem that confronts us at the present moment is not with regard to the general value of radium in relieving symptoms and prolonging life: the specific question is, whether we are justified in resorting to the simple application of radium in cases that are frankly operable, and in which an ultimate cure by surgical means is reasonably possible. The question is now at a critical stage, and will eventually be settled one way or the other by those who with the courage of their convictions are already treating with radium cases that would formerly have been subjected to operation. Meanwhile the frank testimony of every one who is seeing and treating many cases of cancer of the cervix has a certain amount of value, and it is with the hope of contributing something to the general information on the subject that the personal experience of the writer is offered in these two reports.

Our first acquaintance with the radium treatment for cervical cancer was in the early days of the Huntington Hospital. During this period an unofficial plan of collaboration was carried out between that institution and the Free Hospital for Women. The knowledge of the effects of radium on the human tissues was at that time very much in the experimental stage, and our combined results undoubtedly were similar to those obtained by other pioneers in this field. These results do not warrant more than a brief summary. Of the inoperable and border-line cases sent from the Free Hospital for primary radiation, none was permanently cured, though some passed through a brilliant period of apparently complete disappearance and cessation of the disease. Several inoperable cases made operable by radiation were subjected to radical surgery and, with the exception of one patient who died from the operation, they usually lived many months in comfort until fatal recurrence took place. A number of cases of local recurrence following radical operation was treated with radium, and two of these deserve special mention. In one the treatment caused the disease to disappear, but resulted later in a very large vesico-vaginal fistula, which after two operations was permanently closed. The patient lived nearly 3 years after the radium treatment and 5 years after the radical operation, the cause of death not being ascertained, though it was probably from a recurrence. The second case, cited in my previous paper, developed a local recurrence 5 years after an extended operation. Radium treatment at the Huntington Hospital was followed by an intense local and constitutional reaction. The patient recovered, unexpectedly escaping a fistula, and is now entirely well, 6 years after the radium treatment and 11 years after the original operation.

Prophylactic treatment following operation after several trials was given up on account of the danger of burns and later fistulæ. In 1916, the Free Hospital acquired 100 milligrams of

radium. Similar results have followed, except that the danger of overdosage, too frequent application, and inadequate screening having been learned, fistulæ have become less common and have now almost but not entirely ceased to appear.

A statistical report of our personal results in the use of radium would be too complicated to include in a paper of this kind, comprising as it does not only cases in which radium was the primary and sole method of treatment, but all kinds of combinations in which it was used in conjunction with surgical operation, or with various other palliative means of treatment. Our results have been characterized by numerous surprising temporary cures, sometimes extending over many months, but eventuating finally in rapidly growing recurrences. In many of these cases the disease was, from an operative standpoint, hopelessly extensive when first seen. The pre-operative treatment of border-line cases as a preparation for operation has proved, for the most part, disappointing. The post-operative application of radium following radical operation during which the disease had not been completely extirpated has, in most instances, undoubtedly been instrumental in prolonging the patient's life in comparative comfort. Two such cases now under observation nearly a year and one-half after operation, are perfectly well without palpable sign of the disease. Previous experience, however, leads us to believe that in both cases recurrence will probably eventually appear.

Conclusions from our personal results must be made guardedly. It may be said that we have not so far as we know cured with radium a single case of inoperable cancer of the cervix. It is to be noted, however, that this statement is the result of individual experience. It is not equivalent to saying that inoperable cancer of the cervix cannot be cured by radium, for there is evidence to the contrary as will doubtless be brought out in the discussion that will follow this paper. In view of the greater successes attained in other clinics than our own, it is also within the range of possibility that some of our own cases now in the so-called "clinically cured" stage may ultimately prove to have been permanently cured.

The logical outcome of our experience is that in view of the uncertain and sometimes treacherous behavior of radium in the treatment of inoperable cases we have not felt justified in substituting it for radical surgery in cases favorable for operation.

It remains now to discuss the surgical aspect of cervical cancer, a trite subject, but one to which new interest has been added by the recent fire of criticism directed at the extended operation, and by the fact that its complete abandonment has been seriously advocated.

Here again I shall contribute the results of individual experience with the hope of aiding in arriving at a truthful solution of the problem.

The following statistical report is a brief recapitulation of that made in my previous paper. There are minor changes in the figures owing to the fact that since the writing of that article several additional operations have been performed. The report represents the combined figures from the respective experiences of my associate Dr. F. A. Pemberton and myself. Since the date of our first radical operation in 1909, 189 cases of cervical cancer have been seen, of which 119 have been subjected to radical operation by the abdominal route. Our operability percentage, allowing for cases that refused operation is 64 per cent. In the series of 119 operations there have been 6 deaths resulting from the operation, or an immediate mortality of 5 per cent. It is to be noted that Dr. Pemberton lost one patient in his series of 20 cases, while the writer had 5 deaths in his series of 99 cases, so that both operators have approximately the same mortality percentage. It is interesting to compare these figures with those of Dr. Cobb who in his last 30 cases reports a mortality of about 5 per cent. The 5 year curability percentage is 27.6 to 34.2 per cent according to the method of computation, while the absolute curability is 16.8 per cent to 18.5 per cent.

In 101 of the 119 operations, the Wertheim technique was carried out more or less completely. In the other 18 operations, no attempt was made to follow the special Werth-

eim technique, the steps of the operation being practically those of an ordinary complete hysterectomy, with the amputation of the vagina made as low as possible. Of postoperative sequelæ due to injury of the hollow organs of the pelvis there have been two, one vesicovaginal and one rectovaginal fistula. The percentage of postoperative fistulæ is therefore 1.7 per cent.

These figures are in no sense spectacular. They are offered on this occasion only because in the opinion of the writer they represent a fair index of the present status of the surgical treatment of operable cancer of the cervix, and because they may be used as an average standard by which to answer some of the recent criticisms of the radical operation. Among such criticisms are those that assert a too great recklessness in attacking the disease and those that charge the surgeon with excessive caution in the choice of his operable cases. The following quotation, also cited in my previous paper, is repeated here in order to counteract if possible an erroneous impression which as a result of its wide publicity it may have created.

> In these days of low mortality percentages attending nearly all major operations, no operation can possibly gain headway which combines with it a shockingly high mortality and large majority of distressing and desperate sequelæ. The effect on the lay mind must be taken into consideration, for while one may have over 50 per cent of ultimate cures among those patients that survive the operation the effect on the average intelligent citizen is abhorrent, if for this number of survivors there have been twenty-five deaths, and for the other twenty-five a wretched existence attended by repulsive postoperative sequelæ, followed by a painful and lingering death.

In the analysis of our series of cases we find that the operability percentage is comparatively high. This is to a certain extent accounted for by the institutional character of the Free Hospital for Women where most of the operations were performed. The hospital, devoted as it is primarily to gynecological surgery, would be likely to draw a greater proportion of operable cases than would the larger general dispensaries. But even allowing for this difference the figure of 64 per cent should be sufficient answer to any criticism that there may have been a judicial shirking in the selection of cases for operation. The mortality percentage of 5 per cent undoubtedy approximates the general death-rate of most of the present day operators, as is fully indicated by the figures of Cobb, and the more recent reports of other operators. The Wertheim operation during the earlier experimental days was undoubtedly attended with a high mortality which may perhaps be designated as shocking, but the same statement may be made of most of the major operations now in common use. No surgical procedure with a present low mortality should be condemned for the failures of its early past. The allegation contained in the above quotation that the "majority of operations for cervical cancer are followed by distressing and desperate sequelæ" is in our opinion overdrawn. It is evident that the writer of the quotation refers to postoperative fistulæ, and one can hardly avoid a comparison on this point between surgery and radiation. As shown by the figure of 1.7 per cent in our series, postoperative fistulæ are in reality uncommon, and certainly this cannot be claimed of the radium treatment. Radium burns of the normal vaginal tissue are, to be sure, being eliminated by improved technique; nevertheless, the possibility of their occurrence is a constant menace. Moreover there is a very great difference between the average fistula from operation and one from a radium burn. The postoperative fistula is small and is practically always amenable to surgical cure even if it involves one of the ureters. The fistulæ from radium on the other hand are as a rule great openings in the bladder or rectum, not infrequently in both, and usually hopelessly inoperable.

The radical operation has been criticized as being too difficult for practical use. It is unquestionably difficult, and should not be attempted until one has acquired a considerable amount of operative skill. This, however, is true of many other major operations. The reputation that the operation has acquired of being impracticable on account of its difficulty is doubtless the result of the exaggerated procedures which some operators formerly advocated and attempted to carry

out. But the days of reckless resection of ureters and bladders, and vast bloody dissections of the pelvis are long gone by. Such operations are, except on the merest chance, only palliative and are open to all those objections which the above-quoted writer has attributed to the surgical treatment of uterine cancer in general. Surgeons now are adopting a saner conservatism both in the choice of cases and in the technique of the operation. Hence the lower mortality, excellent convalescences, and freedom from disabling postoperative sequelæ.

Conservatism in the surgical treatment of cervical cancer has been made more rational by the advent of radium, for the surgeon no longer feels called upon to attack the desperately difficult cases, and if during the process of an operation it becomes obvious that, from a curative standpoint, surgery is not feasible or too dangerous, there is no disgrace in discontinuing the operation or in making an incomplete extirpation of the disease, for experience shows that postoperative radiation in such cases greatly prolongs life.

The problem of treating operable cases of cervical cancer is becoming more and more important on account of the fact that with increased education on the part of the laity and the general practitioner, cancer of the cervix is being detected at an earlier stage than formerly. The figures for permanent curability in our series of cases is rather low but these represent cases operated on more than 5 years ago. I am confident that the curability record of the past 5 years will show a marked improvement, inasmuch as the general run of cases operated on has been increasingly favorable. Cancer of the cervix uteri, notwithstanding the ghastly consequences of which it is capable, is nevertheless peculiarly amenable to curative treatment in the early stages. Whether the ultimate treatment of curable cases shall continue to be surgical or whether surgery shall yield to radiation, the general outlook is encouraging. It depends in great measure upon the success that attends our efforts to educate the laity and profession to an earlier detection of the disease.

THE PRESENT POSITION OF RADIUM IN THE STUDY AND TREATMENT OF UTERINE CANCER

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So much evidence has been furnished of the value of radium in the treatment of uterine cancer that the question is arising whether it is not more effective than operation. Other methods than operation of treating cancer have often previously failed to receive a sympathetic trial because of the cloud of charlatanism that has surrounded their introduction, and in the case of radium, because of its scarcity, the apparent simplicity of its application and the absence of a primary mortality attending its use, an unrivaled opportunity is afforded the unscrupulous physician to exploit its properties for financial gain. The discussion of this subject, therefore, merits the serious attention of such an organization as the American College of Surgeons. A special responsibility rests also upon those who have first become familiar with its use to give their experience unselfishly to the profession.

Radium has assumed an important position in cancer research, and in the study of the histological changes produced by this agent on both tumor and normal tissues numerous new facts are suggested regarding the pathogenesis of tumor growth, its mode of reparation and hints even in regard to the subject of immunity. Because of the excessive reaction that attended the accidental discovery by Becquerel of its biological properties upon human tissues, the name of radium has become synonymous with burn, so that its therapeutic action is generally regarded as that of a caustic. An understanding, however, of the histological changes produced by radium, the study of which in the uterine tissues has materially contributed to our knowledge of the subject, shows this to be a misconception. We find in the uterus the same kind of response of tumor tissue to radiation as in other parts of the body. The embryonal and rapidly growing types are regularly the most responsive: the glandular type more so than the epithelial, and in both, the papillary and less infiltrating are much more responsive than the deeply infiltrating variety. According to the amount of radium, its filtration and distance of application, the tumor cells of certain very cellular types may degenerate and disappear without other visible changes: or, in other less cellular types, an excessive plasma cell and lymphocytic invasion is accompanied by a connective-tissue proliferation and a subsequent smooth and supple fibrosis, which, by encompassing partly or completely degenerated tumor cells, becomes an important factor in the reparative process. Because of excessive dosage or the use of a large amount of β-radiation, this reaction may extend in an undesirable degree to even the neighboring normal tissues, altering their nutrition or causing their necrosis, because of which the reparation is either postponed or entirely prevented. Clinical reparation follows such histological changes in tumors of the uterine cervix after carefully regulated doses of radium with such regularity that this agent appears to have almost a specific effect. Our studies of tumors of the cervix have led us to hope that the presence of certain histological types, which have hitherto not been recognized as having any clinical importance, may be found to be the reason for the regularity of the favorable action of radium. We have observed, for example, a few cases that correspond to the basal celled type of epithelioma, which is regarded among radiologists as uniformly susceptible to radioactivity. We also often find the so-called plexiform type of epithelioma, in which the entire epithelial layer is reproduced, often producing a tumor of essentially papillary type, and one in which lymph-node invasion is relatively late. This type appears to be especially susceptible to radium, although it is difficult to demonstrate by actual statistics, because of the advanced stage which so many of the cases present. In

the frequency of this type, there is also suggested a reason for the comparative infrequency of lymph-node invasion in cancer of the uterine cervix.

It is difficult to define accurately the position of radium in the treatment of uterine cancer. A few competent observers working with a small amount of radium salt, which permits of only moderate variation in the dosage and form of application, have furnished conclusive evidence of its value in advanced stages, and that it occasionally produces an apparently complete regression in cases too far advanced for the operation to be regarded as applicable. The reports of those, to whom the emanation and the resources of a physical laboratory are available, suggest that, in addition to its palliative capacity, it has remarkable curative properties of which the limits are so far uncertain. The writer, from the observation of the effects of radium in over 400 cases of uterine cancer and from the study of its effects on the tissues of other parts of the body, offers the present therapeutic position of this agent in uterine cancer to be as follows:

Radium, in all recurrences, although less effective than in primary lesions, produces immeasurably better results than operation, provided they are not too far advanced and are not so closely related to the bladder or rectum that to cause their regression will produce fistulæ or severe functional disorders. It is impossible to define the limits of growth beyond which the use of radium is undesirable, but it is essential in order to obtain good results to treat cases in the early stages, and, in general, good judgment demands that treatment shall cease within narrower limits of growth than is the case with primary lesions. In numerous instances, however, pain may be relieved, hæmorrhage stopped, and the progress of the growth hindered by one carefully adjusted dose, when the advanced stage of the tumor precludes the idea of a considerable regression. Occasionally, also, a recurrence in less accessible parts of the pelvic tissues may be favorably affected by means of cross-fire radiation. For this purpose it is desirable to use a large amount of heavily filtered radium in the vaginal vault and over the abdominal wall, or, in the latter location, the X-ray may be substituted. The embedding, also, of small tubes in deep tumor tissue without filtration and containing emanation of small radio-active value is gaining results which justify the hope that our present results may be improved.

The discussion of the use of radium in primary uterine cancer has largely centered about the term operability in defining its field of applicability. From a practicable standpoint, the use of this term for the classification of cases gives an erroneous idea of the importance of the operation. In the hands of a few highly trained pelvic surgeons, at the expense of a high primary mortality and numerous complications and sequelæ, a definite percentage of permanent cures has been obtained, compared with which, because of the factor of time, our present estimate of the value of radium must be largely measured by the primary results. Operation, therefore, for the treatment of uterine cancer continues to be performed to an unjustifiable extent, producing unnecessary suffering and mortality, and bringing discredit to both operation and all other sincere efforts to cure the disease. In other words, the growth when it reaches the hands of a competent diagnostician has extended, with few exceptions, to such an extent that palliation is the only justifiable conception upon which to base the treatment. For all cases, therefore, of primary uterine cancer, with few exceptions, radium should be regarded as the method of choice. Of 34 cases, representing about 25 per cent of 139 patients who had applied to the Memorial Hospital for treatment within 3 months after the beginning of symptoms, a primary and complete regression was obtained in 16, or 47 per cent, and a partial but substantial regression in all of the remainder. Of the 16 cases in which the regression was complete, the growth was limited apparently to the uterine tissues in three, and in the other 13, the extra-uterine involvement was not extensive. Of another 34 cases who had applied for treatment within 4 to 6 months after the beginning of symptoms, the disease was considerably more advanced. There were three, however, in which the growth was apparently

limited to the uterine tissues, and in all a complete regression was obtained. In 18, or over 50 per cent, although the involvement of the extra-uterine tissues was considerable and the regression could not be regarded as complete in any, the disappearance of symptoms and restoration to normal health were evidence of the value of the treatment. An improvement followed the treatment in the majority of the others. There was no improvement in a few, and in two instances the patients were, perhaps, made worse. In forming an estimate of the permanency of the primary results, the action of radium upon the tissues extends over such long periods, 6 or more months, that it is idle for the purpose of statistical study to define the condition of a case until at least one year after the treatment. Without the knowledge also gained by operation, it is difficult to define results as measured by the extent of the original lesion. There are numerous cases in these series of cases who are apparently well 2 or more years after the treatment has been made.

The question regarding the use of radium in the so-called border-land cases has become a subject of frequent discussion, and it is in this field, the writer believes, that radium has demonstrated its remarkable value. With a properly adjusted dose and form of application, radium may be expected regularly to destroy all intra-uterine tumor tissue, and it is capable of destroying extra-uterine tumor tissue to a depth fully within the limits of what is generally regarded as operable with more certainty than operation. We know that cases judged to be outside the limit of operability are frequently made to appear to be well within such limits after the use of radium, and the limiting of the field of operability by surgeons who are only using a comparatively small amount of the radium salt, gives ample confirmation to this opinion. The question of operating in this type of case after radium has produced an apparent regression must await the reports of final results, but the histological changes that radium produces in the extra-uterine tissues show that such a procedure is probably erroneous. If radium has caused a complete destruction of tumor tissue, operation, of course, is unnecessary. The presence of tumor cells in the extra-uterine tissues after treatment can only be definitely known by means of the microscope, and the encasement of such cells by a fibrous framework of connective tissue will be destroyed by the knife, and the cells will thus be given the chance of renewing their original activity. There is naturally a tendency on the part of surgeons to use radium as an adjunct to operation instead of as a substitute, either in advanced cases after removal of as much of the growth as possible, or, prophylactically, in early cases immediately after operation has removed all gross evidence of the disease. In the first instance, I think that its use should be discouraged. We have abundant experimental and clinical evidence that cutting through tumor tissue markedly increases the growth capacity of tumor cells, and our primary results in advanced cases show that radium can produce effects unobtainable by operation. We also know what a favorable site for the application of radium exists in the cervical canal, and to remove the uterus takes away this advantageous position, and so greatly diminishes the chance of success with this agent. As a prophylactic measure in early cases, although not so efficient as when used prior to operation, its use should be encouraged, either by the X-ray or radium over the abdominal wall, or by insertion of a radium capsule in the vaginal vault within a rubber tube or the gauze that may be used for drainage, or by both portals. The radium should be heavily filtered and considerable caution must be used against injury to the pelvic tissues. It is too early to predict the advantage which will result from this use of radium.

There are numerous cases of the cauliflower type, in which a bulky and necrotic tumor of the cervix projecting into the vaginal canal often causes anæmia, toxæmia, and severe cachexia. In some of such cases the removal of the tumor by the actual cautery promptly stops the bleeding and restores the patient to a normal condition for a considerable period. The subsequent application of radium to the tumor base may increase the permanency of the result, as often the parametrial invasion is not commensurate with the apparent extent

of the original lesion. Extreme caution, however, must be taken because, either from failure to recognize how deeply radium may extend its effects, or, because of an alteration in the tissues produced by the cautery, they show an unfavorable reaction to the application of radium. In many such cases, therefore, the cautery alone remains the method of choice.

There remains the question of substituting radium for operation in those few cases in which the tumor is plainly limited to the uterine tissues. In the discussion of this question, cancer of the body must be considered separately because of its special anatomical features. Our inability accurately to locate the site and extent of the lesion makes the dosage and amount of filtration somewhat a matter of guesswork. Lymph-node invasion is also more of a factor than in cancer of the cervix, and the sparks, so to speak, may fly far and wide. Two unfortunate experiences in which recurrences followed radium treatment in what appeared to be early lesions lead the writer to believe that, for the present at least, radium alone cannot be regarded as a safe substitute for operation. There is, however, no experimental or clinical evidence that radium, unless grossly mishandled, will stimulate or unfavorably affect such lesions. The writer, therefore, believes that the application of radium 1 or 2 weeks prior to operation will materially improve the results that have hitherto been obtained by operation alone.

In early cancer of the cervix, the primary results already obtained give undoubted evidence of its remarkable value. Lymph-node involvement, however, although it does not have the same relative importance as in many other locations, is a factor in a definite percentage of cases, and there is no way of definitely ascertaining the involvement of these nodes except by an exploratory operation. We are also, unfortunately, not yet able to depend upon either the X-ray or radium to prevent invasion of lymph nodes or to cause their disappearance if involved. For these reasons, therefore, radium cannot entirely supplant the operation in all of such early lesions in the cervix. But here also an application of radium prior to operation must be regarded as an important factor in our efforts to accomplish a permanent cure. The writer has treated seven such cases by radium alone without observing up to the present time a recurrence. Three of the cases have been well for more than 3 years.

The question naturally arises whether such results may be obtained by those in possession of comparatively small amounts of the radium salt. Much of the discussion relating to the use of massive amounts of this agent has created a false conception of the subject of radium dosage. With the exception of a little experimental evidence obtained from observing the effects upon normal tissues in animals, we know little of the comparative effects upon tumor tissues of a small amount of radium applied for a long time and a large amount applied for a short time. The writer's experience leads him to think, however, that, in addition often to the greater convenience for both patient and physician, the use of large amounts for short periods, in cases of cancer of the cervix, has the advantage of avoiding occasionally rectal and vesical irritation. The application to the cervical canal, usually being the geometrical center of cervical cancer, is the most important part of the treatment, for which a comparatively small amount of the radium salt is perfectly satisfactory. The surface application to the cervix and adjacent tissues may, perhaps, be often more easily made by the use of the emanation, which permits of greater variation in the form of application. There also appears to be an advantage occasionally in rimming the periphery of the cervix at the vaginal insertion with tubes of emanation embedded in the tissues at depths which vary with the extent of the lesion. The embedding of these tubes also in the parametrial tissues at some distance from the vaginal insertion will add to the efficiency of the treatment. The amount of advantage to be gained by applying the X-ray or radium to the abdominal wall has not yet been definitely determined. There is urgent need of more attention on the part of those using a small amount of radium salt to filtration and the type of rays used. The avoidance of the use of the soft β-radiation, either by the use of proper filters

or by obtaining distance by means of vaginal gauze packing, will add materially to the clinical results. One need only observe the difference in the histological changes produced by β- and γ-rays to be convinced of the clinical importance of this part of the technique. A better appreciation also of the undesirable effects of radium upon infected and necrotic tumor tissue will aid in the prevention of numerous unfortunate results. In general, the chief error in the use of radium is overdosage, by which the nutrition of the neighboring normal tissues is so altered that reparation is postponed or entirely prevented. Failure to recognize how many weeks and months the action of radium upon the tissues persists often leads to a premature repetition of the treatment and a disastrous result that might otherwise have been successful.

Lastly, a strong plea is made to avoid treatment of primary cases that are too far advanced. Unless this warning is generally and promptly heeded, much unnecessary suffering will continue to result, and radium will soon be as discredited as is the operation, in the eyes of the public. There are numerous primary cases in which the general health appears to be little, if at all, affected, but in which the local lesion has advanced so far that all of the normal anatomical relations of the pelvic structures are obliterated. To treat such cases will result only in the premature production of the terminal stage of the disease.

THE SEQUELÆ AND LATER ASPECT OF THE TOXIC ALBUMINURIAS OF PREGNANCY[1]

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IN employing the above rather broad terminology to designate a greatly varying complex due or incident to pregnancy and embracing every clinical picture from the mild albuminurias to eclampsia with its own variable pathology, I have been impressed, both from clinical observation and from the literature, with the futility of any classification, either upon a clinical or pathological basis, except, of course, in those cases of frankly chronic nephritis. Indeed, in considering mild albuminuria and slight œdema there is a tendency to lose sight of the one great factor in maternal mortality in these cases, for if we except the relatively rare premature detachment of the placenta, the mortality of the nephropathias is the mortality of eclampsia.

Zangemeister (17) designates all kidney affections brought about through pregnancy, "nephropathia gravidarum." Baisch (1), however, employs this terminology for albuminuria without casts or œdema, reserving for the more severe types the term "pregnancy nephritis." Stoeckel would include all forms under the caption "renal insufficiency." The cases herein presented are in no sense selective beyond the fact that they are almost without exception of the type demanding hospitalization; representing for the greater part the more severe type of the toxic albuminurias as exemplified by an ascending and persisting increase in the arterial tension plus an albuminuria. Fifteen of these patients developed convulsions before, during, or after delivery, and three, "abruptio." All of these women with one exception were delivered at St. Luke's Hospital. Unquestionably the greater number of these cases, in particular those responding to rest, dietetic and eliminative measures, do not reach the hospital, accounting, perhaps in a large measure, for the number of these women developing eclampsia.

The scope of this paper does not include any discussion of the symptomology of this group of affections beyond an attempt to convey a picture of the symptom complex upon admission to the hospital, and the renal findings and arterial tension upon dis-

Read before the Chicago Gynecological Society, December 17, 1920. For discussion see p. 568)

TABLE OF CASES

Admission to Hospital	Clinical Findings	At Discharge	Subsequent Pregnancies	Status Præsens
Case 1 4-10-10 Para-I, 26 6th month	Blood pressure 218–124. Albumin, granular and hyaline casts. Headache, œdema, visual disturbance.	5-4-19 Trace albumin, no casts. Blood pressure 144–80.	None.	General health fair. Blood pressure 136–90. Trace albumin, no casts. 2nd aortic accentuated. Some dyspnœa.
Case 2 1-13-16 Para-I, 36 Term	Blood pressure 130–90. Trace albumin, no casts. Labor 1–16–16. Convulsions. Blood pressure 195. Albumin ++, granular and hyaline casts. Headache.	2-16-16 No albumin, no casts. Blood pressure 129–80.	None.	General health good. No albumin, no casts. Blood pressure 140–90.
Case 3 3-2-12 Para-II, Term	Blood pressure 135–80. Albumin +, hyaline casts. Icterus, headache.	3-17-12. No albumin, no casts. Blood pressure 120–60.	None.	General health good. No albumin, no casts. Blood pressure 128.
Case 4 3-1-18 Para-I, 22 7th month	Blood pressure 185–115. Albumin ++, granular and hyaline casts. Headache, œdema, visual disturbance.	3-23-18. No albumin, no casts. Blood pressure 124–78.	1–30–20. 6th month. Abruptio placentæ. Albumin ++, granular and hyaline casts. Headache, œdema, visual disturbance.	General health good. No albumin, no casts. Blood pressure 126–70.
Case 5 8-18-18 Para-I, 20 Term	Blood pressure 140–80. Trace albumin, no casts. Œdema, hydramnios.	9-1-18 No albumin, no casts. Blood pressure 120–60.	None.	General health poor. Endocarditis. Blood pressure 118–60. No albumin, no casts.
Case 6 8-16-12 Para-III, 28 Term	Blood pressure 136. Albumin ++, hyaline casts. Headache, œdema. 24 hour urine 600 ccm.	8-31-12. Trace albumin, no casts.	None.	General health good. No albumin, no casts. Blood pressure 140–60.
Case 7 3-13-13 Para-I, 19 6th month	Blood pressure 126. Albumin +, hyaline casts. Headache, œdema, chorea.	3-27-13. Blood pressure 130. Trace albumin, no casts. Systolic murmur at apex.	None.	Died December, 1918. Cardiac and renal.
Case 8 3-20-16 Para-I, 25 Term	Blood pressure 160–114. Albumin ++, granular and hyaline casts. Headache, œdema, convulsions, coma.	4-13-16. No albumin, no casts. Blood pressure 120–78.	None.	General health good. No albumin, no casts. Blood pressure 126–70.
Case 9 9-8-14 Para-I, 27 Term	Blood pressure 136. Albumin +, no casts. Headache, œdema.	9-24-14. Blood pressure 112. No albumin, no casts.	1–30–20 Term. Blood pressure 150–108. Albumin +, hyaline and granular casts. Œdema, headache, visual disturbance.	General health fair. Blood pressure 140–90. Trace albumin.
Case 10 10–26–15 Para-III, 35 5th month	Blood pressure 130. Albumin ++, granular and hyaline casts. Headache, œdema. 24 hour urine 500 ccm.	11–20–15 No albumin, no casts. Blood pressure 130.	None.	General health fair. Blood pressure 140–70. No albumin no casts.
Case 11 12–29–18 Para-I, 24 9th month	Blood pressure 120–84. No albumin, œdema. Convulsions, blood pressure 190–130. Albumin ++, granular and hyaline casts. Headache, visual disturbance.	1–26–19 Blood pressure 122–90. Albumin ++, granular and hyaline casts. Eye grounds negative.	None.	Health poor, unable to work. Blood pressure 136–84. Trace albumin, hyaline casts. Headache, dyspnœa.
Case 12 8-17-17 Para-II, 30 Term	Blood pressure 176–100. Albumin ++, hyaline and granular casts. Headache, visual disturbance, convulsions.	9–20–17 Blood pressure 134–84. No albumin, no casts.	None.	Health poor, unable to work. Blood pressure 128–88. Trace albumin, no casts. Left ventricle hypertrophied. Headache, arrhythmia, dyspnœa.
Case 13 10–9–18 Para-II, 28 7th month	Blood pressure 184–124. Albumin ++, granular and hyaline casts. Œdema, convulsions, coma.	10–23–18 Blood pressure 164–96. Trace albumin, hyaline casts.	None.	General health good. Blood pressure 132–88. No albumin, no casts.
Case 14 6–4–19 Para-I, 18 Term	Blood pressure 176–108. Albumin +, no casts. Œdema, headache, 21 convulsions.	6–20–19 Blood pressure 116–84. No albumin, no casts.	11–23–20 Term. Blood pressure 160–96. Albumin +, hyaline casts. Operative delivery.	General health good. Blood pressure 120–78. No albumin, no casts.
Case 15 3–5–18 Para-III, 28 8th month	Blood pressure 260–110. Albumin +, hyaline casts. Œdema, headache, convulsions, coma.	3–27–18 Blood pressure 116–84. No albumin, no casts.	7½ months. Blood pressure 170–100. Albumin +, granular and hyaline casts.	Blood pressure 158–90. Hæmoglobin 60 per cent. No albumin, no casts. Apex 2 cm. outside nipple line, 2nd aortic accentuated.
Case 16 10–2–18 Para-I, 23 Term	Blood pressure 140–95. Albumin +, granular and hyaline casts. Headache, œdema, convulsions.	10–22–18 Blood pressure 118–88. Trace albumin, no casts.	None.	General health good. Blood pressure 130–76. Trace albumin, casts. Slight dyspnœa.

Admission to Hospital	Clinical Findings	At Discharge	Subsequent Pregnancies	Status Præsens
Case 17 5-2-19 Para-I, 30 Term	Blood pressure 150-120. Albumin + ++, granular and hyaline casts. Œdema, convulsions, blood pressure 208-104, coma.	5-22-19 Blood pressure 134-82. Trace albumin, no casts.	5 months. Blood pressure 150-90.	General health good. Blood pressure 150-90. No albumin, no casts.
Case 18 10-21-16 Para-I, 25 7th month	Blood pressure 180-124. Convulsions. Albumin +++, granular and hyaline casts. Œdema, headache 3 days.	11-2-16 Blood pressure 156-90. Trace albumin, no casts.	None.	Died 2-10-18. Cause unknown.
Case 19 8-11-16 Para-I, 32 Term	Blood pressure 136-86. Albumin +, hyaline casts. Headache, œdema.	8-30-16 Blood pressure 116. No albumin, no casts.	6-15-19 7th month. Blood pressure 160-90. Albumin +, granular casts. Hydramnios Labor.	General health good. Blood pressure 130-60. No albumin, no casts.
Case 20 5-14-17 Para-I 7th month	Blood pressure 180-90. Albumin, casts. Headache, œdema, convulsions.	5-29-17 Blood pressure 110-60. Trace albumin, no casts.	None.	General health good. Blood pressure 120. No albumin, no casts.
Case 21 2-4-12 Para-I, 25 Term	Albumin ++, hyaline and granular casts Headache, œdema, convulsions.	Trace albumin, no casts.	None.	General health fair. Blood pressure 160-90. Albumin ++ granular and hyaline casts.
Case 22 4-15-19 Para-I, 33 8th month	Blood pressure 190-110. Albumin ++, granular and hyaline casts. Œdema, headache.	4-27-19 Blood pressure 134-88. No albumin, no casts.	None.	General health good. Blood pressure 138-86. No albumin, no casts.
Case 23 5-15 15 Para-II, 27 Term	Blood pressure 185-100. Albumin +, hyaline and granular casts. Œdema, headache, visual disturbance, convulsions.	6-7-15 Blood pressure 140-80. No albumin, no casts.	None.	General health good. Blood pressure 138-88. No albumin, hyaline casts. Eye trouble.
Case 24 3-22-19 Para-I, 26 Term	Blood pressure 190-110. Albumin ++, hyaline and granular casts. Œdema, nausea, headache.	4-5-19 Blood pressure 148-98. Albumin +, no casts.	None.	General health good. Blood pressure 160-90. Albumin+.
Case 25 11-30-18 Para-I, 24 8th month	Blood pressure 150-90. Albumin ++, hyaline and granular casts. Profuse hæmorrhage. Abruptio placentæ.	1-15-19 Blood pressure 130-74. Trace albumin, no casts.	5th month. Blood pressure 148-86. No albumin, no casts.	General health good.
Case 26 10-4-17 Para-I, 30 Term	Blood pressure 144-100. Albumin +++, granular and hyaline casts. Headache, nausea, œdema, visual disturbance, convulsions.	10-22-17 Blood pressure 128-80. Trace albumin, hyaline casts.	None.	General health good. Blood pressure 146-80. No albumin, no casts.
Case 27 1-10-15 Para-I, 27 7th month	Blood pressure 170-100. Albumin ++, hyaline and granular casts. Œdema, 2 convulsions, coma.	2-10-15 Blood pressure 146-86. Albumin +, hyaline casts.	None.	General health poor. Blood pressure 148-82. No albumin. no casts. Headache.
Case 28 5-20-12 Para-II, 34 4th month	Blood pressure 160-90. Albumin ++, hyaline casts. Albuminuric retinitis, headache, œdema.	6-15-12 Blood pressure 150-90. No albumin, no casts.	None.	Died March, 1920. Renal.
Case 29 8-16-19 Para-I, 27 Term	Blood pressure 166-112. Albumin +, no casts. Œdema.	9-4-19 Blood pressure 130-76. Trace albumin, no casts.	None.	General health good. Blood pressure 124-64. No albumin, no casts.
Case 30 1-10-20 Para-II	Blood pressure 146-90. Albumin ++, granular casts. Abruptio placentæ.	2-15-20 Blood pressure 140-90. Albumin +, no casts.	None.	General health good. Blood pressure 127-70. Trace albumin.

charge, for the purpose of deductions relative to the latent morbidity and subsequent pregnancy. All functional kidney tests and blood chemistry based upon the theory of an alteration in the nitrogenous metabolism have been purposely omitted from the tabulation, it being the personal conviction of the writer that they are of relatively slight prognostic value in the determination of an impending eclampsia, indeed too many valuable hours have been lost in securing a normal blood nitrogen and phthalein functional test in the face of a fulminating eclampsia.

Few conditions confront the obstetrician in which the element of time, even hours, may be as vital as in the rapidly increasing

hypertension with albuminuria in the pregnant woman. Of interest upon the clinical side of our eclamptics and pre-eclamptics has been the frequent manifestation of visual disturbance although only two of these cases showed any changes in the background of the eye. Esch (4), who studied the visual disturbance in 46 eclampsias, could demonstrate changes in the background in but 4, indicating that the frequent visual disturbance in these cases is more probably dependent upon the cerebral œdema and increased intracranial pressure than upon actual pathology in the background. Zangemeister (17) believes that retinal changes never occur in the acute nephropathias.

As concerns the frequency of the toxic albuminurias of pregnancy, one gathers from the literature that it lies between 2 and 3 per cent. Paddock believes the incidence of albuminuria considerably above this in our own material. Zangemeister (17) gives 2.7 per cent in primiparæ and 1.7 per cent in multiparæ; the incidence of eclampsia in this material being approximately 8 per cent. Cragin (2) gives 251 eclampsias in twenty thousand consecutive deliveries at Sloan; Edgar (3), 7 in twelve hundred.

It must be admitted that the variable complex, designated the kidney of pregnancy, has had little elucidation since it was first discussed by von Leyden (9) in 1886, and although the internists have given us a fairly complete picture of the symptomology and pathology of both acute and chronic forms of nephritis, the obstetrician who essays carrying the parturient woman, suffering perhaps from a slight œdema and albuminuria, to term or to the more often disappointing "viability," will not infrequently find himself beset with difficulties should he premise his course upon any known clinical data. These difficulties, it would appear, are largely due to our inability to differentiate clinically the transition from the purely degenerative changes in the parenchyma of the kidney to the inflammatory; corresponding to those abrupt changes in the symptom-complex. And yet upon our inability to so differentiate lies perhaps our greatest obstacle in the prevention of eclampsia with its yet considerable mortality and morbidity. Upon the clinical side, however, there is an unmistakable trend toward the belief that the significance of an existing and persisting arterial hypertension cannot be overestimated; indeed, many investigators believe that it is the line of cleavage between the purely degenerative and inflammatory processes.

Queirel (10) in an article upon arterial hypertension in pregnancy making the dogmatic statement that if in a pregnant woman, with a previously normal tension, the hypertension reaches 180 or 190 and persists, an eclampsia is imminent.

Von Jaschke (6), in a recent publication, expresses the view that one can differentiate the purely degenerative or so called nephroses from the inflammatory type by the hypertension and hæmaturia in the latter, with the exception, of course, of certain cases which he believes are of a mixed type.

It becomes apparent from a study of contemporary literature that the question of a permanent or latent morbidity, or, if you please, a continuation of the kidney begun in pregnancy, has not been given the consideration its importance justifies, and existing literature shows a striking variance of opinion among those who have written upon this subject. To be sure a considerable number of these cases should be under observation for a period of years after delivery for logical deductions, yet evidence is not wanting that permanent damage to kidney and myocardium are by no means infrequent. Against the probability of a continuation of the kidney begun in pregnancy we find Whitridge Williams (13) who believes that chronic renal disease rarely results from the pre-eclamptic toxæmias and that if recurrence takes place in a subsequent pregnancy the subject belongs to the nephritic type of the toxæmias of chronic nephritis. Rosenstein (11) and Esch (4) believe it exceedingly rare. For the probability we find Zangemeister, von Jaschke (6), and Koblanck (8) who demonstrated a chronic nephritis in 6.5 per cent of his 77 cases examined postpartum. Koblanck's cases were all examined within a period of 6 months postpartum; a factor I believe calculated to give a more favorable

status than a later examination. I should state that in all of our cases one year has elapsed prior to final examination. A general survey of our material shows three cases dead at 1, 5 and 8 years respectively, one, of unknown cause and two of renal and cardio-renal affections. Of our 14 remaining eclamptics 5 have a well marked nephritis with hypertension, and 2 have an arterial tension suggestively high. Of the 12 we have designated pre-eclamptics, 2 have a clinically well marked nephritis. Of the three "abruptios" a condition Zangemeister believes does not exist in the absence of a chronic nephritis, it is of note that Case 4 after two exceedingly severe albuminurias with hypertension shows no clinical evidence of a nephritis at this time. Case 25, an "abruptio," reported recently at the prenatal clinic in the fourth month of her second pregnancy with a tension of 148-88. It may be urged in objection that one cannot exclude a pre-existent nephritis in any of these women, and reasoning from a purely scientific premise perhaps not. Yet the fact must be given consideration that four of these women were day workers and laundresses, women accustomed to hard physical labor, in whom any suggestion of invalidism was wanting prior to their pregnancy, yet whom we must classify as physically incapacitated at the present time. I can find no justification for the assumption of a pre-existent nephritis in these women as all cardiac and renal symptoms were absent *prior to the onset of an acute nephropathia.* Indeed, it has been generally conceded that while the woman with a chronic nephritis has her life expectancy materially shortened by a pregnancy she is not so liable to eclampsia, a fact accounted for by Fehling (5) upon the grounds of a compensating hypertrophy of both kidney and heart in these cases with the corresponding increase in the elimination of urine. A good example of this might be cited in Case 15, a frankly chronic nephritis from the period of her eclampsia.

I have refrained from any discussion of chronic nephritis in relation to pregnancy believing that no illusions are held relative to the status of the pregnant chronic nephritic.

Of paramount importance to the obstetrician is the question of recurrence in a subsequent pregnancy, for he will not infrequently be questioned relative to the hazard of a future pregnancy particularly where a premature babe unequal to extra-uterine existence has been delivered. That prematurity is the most frequent complication of the entire group of the toxic albuminurias is axiomatic.

Baisch (1), I believe, gives 47 stillborn babies in his series of 216 cases of "pregnancy nephritis" a designation he reserves for the more severe nephropathias, inclusive, of course, of eclampsia. In truth, a dispassionate consideration of the toxic albuminurias of pregnancy of necessity involves the subject of prematurity and all that this entails, in particular as it relates to the later development of these infants, and here one finds little encouragement for the conservative treatment of the expectant mother based upon the procuring of a viable child.

Ylppoe (15), in a recent monograph upon the physiology and later history of the premature infant to the school age, presents a study of 668 premature infants, reckoning as premature all having a birth weight of less than 2500 grams. This series shows a mortality of 50.33 per cent during the first year and that a total of 320 did not survive the fourth year. To this appalling mortality curve which, of course, drops enormously after the first year, he finds a not inconsiderable morbidity largely accounted for by birth traumas, cord and brain hæmorrhage predominating (16). It would seem from his large number of autopsies that the premature infant escaping an operative delivery suffers in a large degree from cord and brain hæmorrhages.

Baisch in the 216 cases previously mentioned gives an operative delivery as necessary in 124 of the cases, or 55 per cent.

In a postpartum study of 23 eclamptics Wolff and Zade (14) found 8 of the 23 pregnant the second time. Four of the eight showed distinct renal disturbance, two of these repeating their eclampsia. We believe that the possibility of recurrence is generally conceded by obstetricians.

Of our 27 cases who have survived to the present time, we find 7 with a subsequent pregnancy, probably a fair percentage when one considers the character of the first pregnancy. Of the 5 whose pregnancy has terminated, 4 were discharged from the hospital at the termination of the first pregnancy, it will be noted with an absence of casts and albumin and a normal arterial tension and in the second pregnancy all were perhaps under more than casual observation by reason of their previous history. Of these we find one "abruptio" at the end of the sixth month with accompanying albuminuria, casts, hypertension, and visual disturbance; one premature delivery with hydramnios, albumin, and hypertension; one moderately severe albuminuria with some hypertension; one operative delivery indicated by a rapidly increasing tension and albumin, a woman subjected to weekly examinations in the prenatal clinic by reason of her previous eclampsia and who reported at the clinic in the first stage of labor with no evidence of toxæmia nor albumin and a tension of 126-88, yet in whom after 16 hours of labor we find albumin, casts, and a tension of 160-90. Case 15—an eclamptic also under weekly examinations in the prenatal clinic, was admitted at seven and a half months—with a tension of 186-90—for the termination of the pregnancy, labor, however, developing spontaneously and a 4½ pound infant delivered.

Two remain undelivered, Case 25, an "abruptio" now in the fourth month of her second pregnancy with a tension of 148-88 but no albumin or casts, and Case 17, a previous eclamptic now in the fifth month of her second pregnancy, with a tension of 152-84 also without casts or albumin. In the interim between the first and second pregnancies none of these women with the exception of the chronic nephritic above mentioned (Case 15) gave a complex at all suggestive of chronic nephritis as given for example by Strumpell (12). all evidence of cardiac and renal pathology being absent.

In conclusion I would like to express the conviction that freedom from albuminuria with a normal arterial tension following a toxic albuminuria in the course of one pregnancy is by no means a sure criterion of its non-occurrence in a subsequent one. As to the wisdom or expediency of a subsequent pregnancy in this group of affections one may say possibly it may be permitted after a protracted interval of normal arterial tension and freedom from any evidence of renal incapacity and after due consideration to the three outstanding hazards—*first, irreparable damage to kidney and heart; second, prematurity; third, eclampsia.*

Personally, in view of our limited knowledge of the nature of this entire group of affections, I can find no justification for placing the woman in jeopardy a second time, for although the etiology and nature of eclampsia are obscure, the mortality and morbidity are by no means so. Surely one may say without exaggeration, there is no statute of limitations for the kidney of pregnancy.

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NASOPHARYNGEAL ENDOTHELIOMA

A Report of Two Cases, with Late Metastases to the Chest in One

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ENDOTHELIOMA of the nasopharynx is not excessively rare. It is difficult to judge of its exact frequency. Endotheliomata have not been clearly defined from carcinomata on the one hand and sarcomata on the other. Some writers on tumors of the nasal passages report a considerable percentage of endotheliomata; others classify their tumors almost entirely as carcinomata and sarcomata. However, Pollack (1) in 1911 was able to cite 50 cases.

Nasal endothelioma has been considered a non-metastasizing tumor. The literature at our disposal has disclosed but one record of metastasis, and this we have not been able to verify (2). Those authors who mention metastases at all agree that they are uncommon. Pollack says: "Clinically the group of endotheliomata is characterized by slow growth and little tendency toward metastasis, but on the other hand, by an obstinate inclination toward local recurrence." Althoff (3), who reported three cases in 1907, states that metastases are rare. Sakai (4) illustrates in one of his plates a bone whose marrow spaces are filled with endotheliomatous cells. This is the nearest approach to a metastasis that we have been able to find.

It is easy to see from Sakai's excellent plate how endothelial tumor cells that have entered the sinuses of the marrow might be dislodged, and float off in the blood stream to distant organs.

It may well be that endotheliomata of the nasopharynx are more frequently disseminated than the literature would lead us to believe. Most records of patients suffering from endothelioma are extremely defective. Most of the patients have been examined by specialists alone. More complete examinations, longer periods of observation, and more detailed autopsy records might disclose other metastases like the one we are reporting.

There are many records of autopsies performed on patients who died while under observation, but they give no account of a search for metastases anywhere below the neck, even though some of the tumors had become very large by extension. One reported by Durante (5), for instance, involved the brain extensively.

The clinical records are equally meagre. Examination of most of the patients seems to have stopped at the level of the clavicles. The records give evidence of no other than the rhinological examination. The patients were followed for longer or shorter periods and then discharged as cured.

Now, although endotheliomata are little likely to be scattered, and although radical operation seems to offer good chances for complete cure, late metastases are not impossible. One of our patients died of metastases 5 years after operation.

We are reporting these tumors, therefore, in order to urge that patients with endotheliomata of the nasal passages be observed over a longer period than has been customary, that they be examined completely and thoroughly at regular intervals, not by rhinologists alone, but also by internists or general surgeons, and that autopsies performed on those who die while under observation be undertaken with a view to discovering distant metastases.

Case 1. Mr. T. D., age 57, presented himself for treatment at the Nose and Throat Clinic of the Stanford University Medical School, February 9, 1915, complaining of a large swelling of the right upper eyelid, his appearance being shown in Figure 1. Examination showed both nostrils filled with a polypoid mass which protruded externally on both sides. There was a swelling over the right frontal

Fig. 1. Patient T. D. before removal of endothelioma of antrum.

Fig. 2. Patient T. D. after removal of endothelioma of antrum.

sinus and an exophthalmos with displacement of the right eye downward and outward. The right upper lid fluctuated. The roentgen examination showed "very marked enlargement of the frontal sinuses, some clouding of the left maxillary sinus—marked clouding of the nares."

Operation was performed by Dr. H. B. Graham on February 10, 1915. An abscess was evacuated over the right eye. A Killian operation was performed and a gelatinous polypoid mass was evacuated from the frontal sinus. The floor and posterior superior walls of the sinus were eroded. The ethmoids and sphenoids on the right side were opened and a Luc-Caldwell operation was done on the right antrum. The antrum, ethmoids, sphenoids and nose were all filled with the same mass as was found in the frontal sinus. The left nostril was not interfered with. Examination of the tissue removed showed it to be an endothelioma.

Roentgen-ray treatments were begun at this time, twenty irradiations (one every 3 weeks) being given until April 5, 1915.

March 15, 1916, 13 months after operation, the patient was feeling very well and was given 24 milliampere minutes with 145 volts. This was repeated on April 5, 1916.

April 24, 1916. Small stumps of left middle turbinate and tags of tumor growth were removed.

On January 12, 1917, the nose was comparatively clear and in 1918 there was no growth in the nose. Thus 3 years after operation he showed no signs of recurrence nor metastasis and was apparently cured (Fig. 2).

On March 19, 1920, the patient was admitted to the Stanford Medical Ward of the San Francisco Hospital. The history given above was unknown to us until later. He had complained for 6 months of "lumps on the ribs and pains about the chest."

Examination showed considerable emaciation, a very wide nose and marked outward deviation of the right eye (Fig. 3). At the second and third left chondrosternal junctions there were two tender masses covered by normal skin, the size of large walnuts, of firm but not bony consistency.

The left side of the diaphragm moved much less than the right. Percussion and auscultation revealed nothing abnormal on the right side, but on the left there was dullness anteriorly which extended into the axilla. Over this dull area the breathing was tubular and distant. The patient had a cough. He raised some clear, non-purulent sputum in which no tubercle bacilli were found. The urine, spinal fluid and blood were normal except for a leucocytosis of 14,800.

Roentgenograms of the chest showed "a large tumor mass at the left lung extending from the hilus region" (Fig. 4).

The patient continued to lose weight, became more dyspnœic, and the nodules described above enlarged slightly. On March 29, the upper, larger one was definitely fluctuant. On April 6, a small incision was made over the larger nodule, under local anæsthesia, and a small piece of soft gelatinous tissue was obtained which on examination proved to be endothelioma (Fig. 5).

Fig. 3. Patient T. D. with metastasis of chest 5 years later. *a*, Metastatic tumors.

Fig. 4. Roentgenogram of chest showing mediastinal metastasis.

The patient continued to become more dyspnœic and cyanotic and died on April 14, becoming delirious before death. A necropsy was refused by relatives.

It is logical to assume that the tumor within the chest was of the same nature as the nodules on the chest wall. The tissue removed from this nodule shortly before death and that removed at operation over 5 years previously, both being endotheliomata, lead us to the conclusion that the original tumor had metastasized to the trunk and set up a secondary growth probably in the mediastinum.

Case 2. Dr. E. H., age 56, born in Ireland, was first admitted to the San Francisco Hospital (Stanford University Service), April 10, 1913.

He stated that he had had a nasal discharge for years. Ten weeks prior to his admission he had had a severe hæmorrhage which seemed to come from the right side of the nose more than from the left; since then he had had nine such hæmorrhages. He had very little pain.

On examination he showed a severe conjunctivitis of the left eye with a purulent discharge. There was a suppurating sinus below the inner canthus of the left eye. There was a purulent discharge from both nostrils. The left nostril was pushed over somewhat to the right. The left cheek was pierced by multiple sinuses from which yellow pus exuded but was not tender. The left side of the hard palate was somewhat reddened but not tender. The left cervical glands were hard, freely movable under the skin and not adherent to each other. The right cervical glands were palpable. The inguinal, epitrochlear and axillary glands were not much larger than normal. The heart was enlarged; the radial arteries were sclerosed. There was increased resonance over the apex of the left lung. The liver stood two fingers breadth below the ribs. The patient had the appearance of a chronic alcoholic.

The urine contained a little albumin. The sediment showed a few hyaline casts.

The patient's rectal temperature varied from 99.4 to 101.6. The pulse varied from 76 to 96.

Operation, Dr. Rixford. April 12, 1913. Dieffenbach's incision was made following the line of the lower lid, the nose, and down the philtrum of the upper lip, but not extending through the mucosa of the upper lip. The anterior surface of the upper jaw was cut away, the zygoma sawn through, and the antrum opened. The antrum, ethmoidal sinuses, and perhaps the sphenoidal sinuses were filled with masses of soft, white tumor, almost gelatinous in places, containing large pockets of pus throughout its substance. The infra-orbital plate seemed perforated in places. The tumor was removed as

Fig. 5. Patient T. D. Sternal metastasis. Microphotographs (Figs. 5 and 6) by Dr. Jean Oliver, Stanford Medical Department.

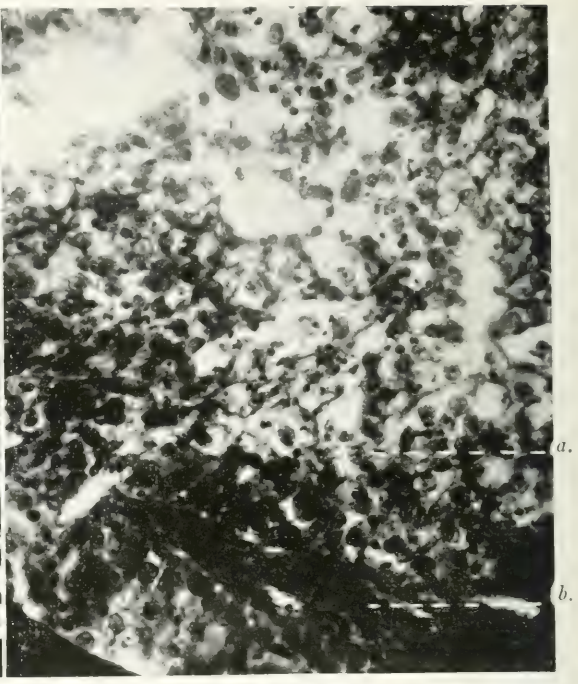

Fig. 6. Patient E. H. Section of tumor showing endothelial tumor cells growing from framework of capillaries. *a*. Endothelioma cells; *b*, capillary.

far as visible with the finger and the curette, and the bone bitten away with the rongeur where it was evidently infiltrated. The growth was of such extent that its origin was uncertain, the whole cavity of the nose and the adjacent sinuses being filled with it. The cavity of the mouth was opened in one place at the upper gum. Although all macroscopically visible tissue was removed, no attempt was made to do an extensive resection. In order to have done this the orbit would have had to be exenterated, or its lower floor at least removed. The cavity of the mouth was closed as well as possible with catgut sutures taken through the mucosa of the upper lip and gum, a drain was led into the bed of the tumor and out through the nostril, and the flap was sewed back into place with interrupted silkworm gut. Time, one hour. Inconsiderable hæmorrhage followed.

Dr. Ophuls' report: Clinical diagnosis: tumor of nose; source of material: section of tumor.

Sections show framework of very cellular, dense, fibrous tissue in which there are large irregular spaces filled with large polygonal cells which show a very definite outline, a clear, entirely transparent protoplasm and a central nucleus of moderate size. No intercellular substance between the cells. The groups of cells are quite sharply separated from the adjoining connective tissue.

Carcinoma (endothelioma?) of nose (Fig. 6).

The packing was removed on April 14. The wound healed well and patient was discharged from hospital May 26. There was very little deformity of the face, but there was a little subcutaneous emphysema of the lower left eyelid, which the patient could produce at will by blowing his nose.

He was readmitted September 1, 1913, without having been seen since his discharge in May of the same year. He complained of a foul discharge from the nose, but stated that he had had no further hæmorrhages. He did not think that the tumor had increased in size. He had no pain or headache. The vision of the left eye was unimpaired, there was no proptosis, and the diplopia which was present following operation had disappeared. His appetite was good but he had lost considerable weight. He had had a good deal of dyspnœa on exertion and had had œdema of the legs, especially the right one. He had noticed that his sense for the taste of sugar and salt had been disturbed for the past 6 months.

His nose was large and flat and retracted to the left side of the face, which was puffy over the region of the left maxilla. Both upper and lower left eyelids showed a brawny infiltrate, and patient stated that the swelling of the eyelids greatly increased when he blew his nose. There was a foul discharge from both nostrils.

There was increased resonance with fine râles over the base of both lungs. There was pitting œdema of both ankles, especially the right. The cervical glands were not enlarged. He was operated upon September 9.

Reoperation by Dr. Rixford. Ether. Time, ¾ hr. An incision was made in the old scar, but only down to and not through the lip, *i. e.*, an angular incision in the infrapalpebral and in the nasolabial fold. The flap of cheek was turned back and exposed foul tumor masses. A portion of the infra-orbital plate involved by them was chiselled away, and the tumor masses removed with finger and curette. Some of the sphenoidal and ethmoidal sinuses which remained unopened at the first operation were opened; they were filled with tumor and were cleaned out. The base of the skull was reached, and the roof of the pharynx bared. The dura was not opened. The nasal septum was involved, the cartilage yellow and necrotic. It was removed. There was little bleeding. At the end of the operation no further tumor tissue remained visible. A portion of the scar was excised from the edge of the flap, which was returned into place and fastened with a few silkworm sutures. The cavity was packed with gauze which was led out of the left nostril.

Patient made a smooth recovery from the operation until October 8, when there was a moderate hæmorrhage from the nose. On October 9 and 10 the bleeding recurred. On October 11, an incision was made through the old scar and the tumor cavity curetted and packed.

On October 17 the patient drank one ounce of oil of lavender "by mistake." The next day he became delirious and restless and wandered about the ward. A neurological examination showed no evidence of meningitis. The spinal fluid was clear and contained 40 lymphocytes per cubic centimeter.

On October 23, 1913, friends of the moribund patient caused him to be removed to another hospital.

No autopsy was held.

Whether the delirium was caused by poisoning from the oil of lavender which the patient had drunk, or from the iodoform gauze used for packing, or from a uræmia consequent upon his old nephritis, was not made clear.

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ANGIOMA OF THE PLACENTA

With Pathological Report and Microphotographs by Dr. Frank B. Mallory, Director, Pathological Laboratory, Boston City Hospital

By JOHN T. WILLIAMS, M.D., F.A.C.S., Boston

THE poverty of American literature on tumors of the placenta has led the writer to report in detail the following case and to add a brief review of the foreign and such American writings on the subject as can be found. The complete bibliography which is to be found at the conclusion of this article is sufficiently voluminous, but the condition seems to have engaged the attention of continental European obstetricians mainly. American textbooks of obstetrics pay little attention to placental tumors with the exception of Williams, who gives a short but thorough section. DeLee dismisses the subject as of little importance only rarely affecting the child or the delivery. While this was true of the case to be reported and of a number of others, there is nevertheless some ground for belief that these growths are not always innocuous.

We have found in all seventy papers on this subject, covering 83 cases. Not all of these, however, are undoubted instances. Up to 1906 various forms of neoplasm were reported: myxoma fibrosum, fibroma, angioma, sarcoma, and hyperplasia of the chorionic villi. In that year, however, Pitha, after a careful scrutiny of the descriptions given by the different writers, came to the conclusion that these growths were all identical, consisting chiefly of blood vessels with a varying amount of fibrous tissue, and all should be

Fig. 1. Placenta showing one large and one small tumor mass embedded in its wall.

designated as chorio-angiomata. This view obtained speedy acceptance, but, in 1914, Cary, of New York, reported an undoubted case of sarcoma of the placenta, in which his diagnosis was confirmed, after examination of the specimen, by Whitridge Williams. This specimen is unique and to date has not been duplicated.

Walz also has reported a unique case—a sarcoma of the placenta secondary to sarcoma of the thigh. There was also a metastasis in the lung. This is the only instance of a secondary neoplasm of the placenta on record.

Applegate, of Philadelphia, has reported myxofibromatous degeneration of the placenta occurring in four successive pregnancies in the same patient. Death of fœtus *in utero* and premature delivery took place in each pregnancy, and two of the fœtus were deformed. It is not clear from his description whether his observations were those of tumor formation or of diffuse myxofibromatous change.

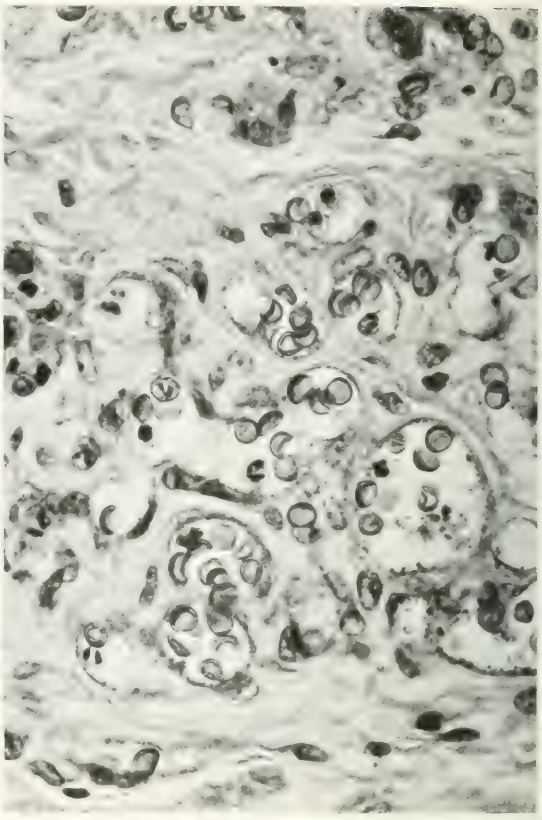

Fig. 2. Field showing typical structure of tumors. In one capillary are two nucleated red blood corpuscles. X 500.

Practically all the tumors recorded were discrete, never involving as much as half the placenta. They were all more or less encapsulated, situated in the substance of the placenta, but in contact with the chorion, and resembling somewhat the appearance of a kidney on gross inspection.

As regards the effect upon pregnancy and labor, and the child, Albert, in 36 cases collected up to 1898, found that premature labor occurred in 13, hydramnios in 4, manual removal of the placenta was necessary in 3, and postpartum hæmorrhage followed in 5. We have been able to obtain accurate data concerning the labor of 25 of the cases reported since his paper, which give similar figures. Of these 25, labor was spontaneous and at term in 16, and of these only 1 child died; but in 9, or 36 per cent,

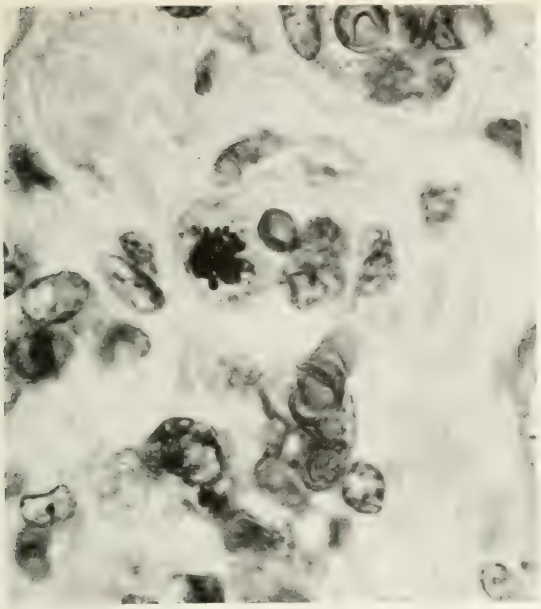

Fig. 3. Monaster in endothelial cell lining a capillary. X 1000.

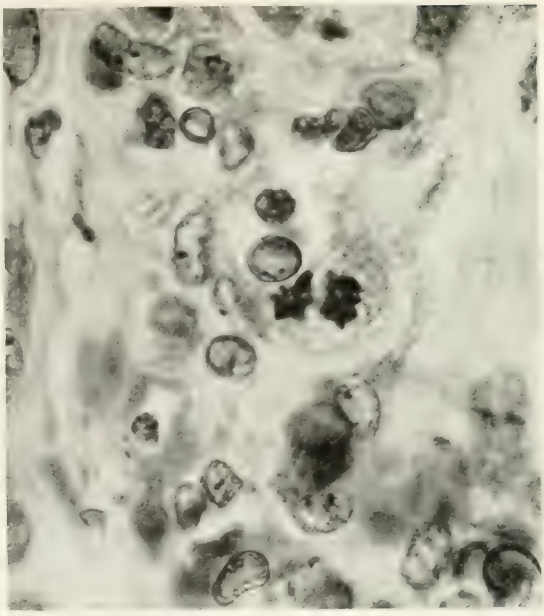

Fig. 4. Diaster in endothelial cell lining a capillary. X 100.

labor was premature, and of these children only 1 survived. Hydramnios was noted four times in all, but difficulty in delivery of the placenta occurred in only two.

Mrs. L. J., age 22, primigravida, delivered May 6, 1920, by low forceps after 12-hour labor because the head had been on the perineum one-half hour without progress. The child was normally developed, weighed 7 pounds, 14 ounces. The placenta was expressed 30 minutes after delivery of the child without the slightest difficulty, by gentle application of the method of Credé, and was found to present the appearances described below.

PATHOLOGICAL REPORT BY DR. MALLORY

Gross examination: Placenta 20 by 16 by 2 centimeters with normal-looking membranes, and cord measuring 47 centimeters. At one edge of the placenta, adjacent to the origin of the cord, there is a compartment in the placenta from which a rounded mass shells out, retaining an attachment to its bed by means of a cord-like structure 17 centimeters in length and 2.9 millimeters in diameter. This mass is in the shape of flattened sphere measuring 10.5 by 10 by 6 centimeters. Its surface is divided into five coarse lobules, over the surface of which and between which large blood vessels run. The mass is soft and elastic. Its surface is covered by a smooth, transparent membrane, beneath which pale, pinkish gray, tissue is visible. There are yellowish, gelatinous, translucent areas, and dark red irregular opaque areas. The mass cuts with some resistance, showing a soft elastic, wet surface, of almost uniform gray-pink color. The surface is not friable.

The cord-like attachment which links this mass to its bed is inserted into the mass by a single trunk which disappears into a cleft between two lobules. It arises from the bed of the mass in the placenta from five smaller vessel-like structures which fuse into one trunk ½ centimeter above the origin.

The bed in which the mass lay has a base of normal-looking placental tissue. Arising from this is a curtain-like septum of thin membraneous tissue, resembling chorionic membrane, which separates the tumor cavity from the amniotic cavity.

At one edge of the tumor cavity, and connected directly with the placenta, there is a rounded mass, 3.5 centimeters in diameter,

of tissue resembling in all respects the larger mass described above.

Microscopic examination shows the tumors to be composed of thin-walled capillary blood vessels embedded in a fairly abundant connective-tissue stroma. Mitotic figures, indicating rapid growth, are present in many of the endothelial cells lining the vessels. Some of the red blood corpuscles in the capillaries are nucleated. Diagnosis: multiple capillary hæmangio-endothelioblastomata.

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ANALYSIS OF THE RESULTS OF TREATMENT OF FRACTURES OF THE FEMORAL DIAPHYSIS IN CHILDREN UNDER TWELVE YEARS OF AGE[1]

By KELLOGG SPEED, M.D., F.A.C.S., Chicago
From the Department of Surgery, Rush Medical College, and the Cook County Hospital

In our children's surgical ward during the last year we have made an attempt to bring the treatment for fracture of the femoral shaft up to the latest standards. Also a comparison has been attempted of the different methods of treatment. Fractures of other parts of the bone are not included in our résumé, nor are any cases in which treatment is still in progress. The records of a few patients have been misplaced so that they cannot be included. No open operations on fractures of the femoral shaft are considered in this list because an effort has been made to avoid operations on these young children suffering recent fracture.

No child after such fracture showed any noticeable disability in the limb joints, regardless of the method of treatment used. When suspension traction was employed we took every precaution to avoid foot-drop and to encourage active knee and ankle motions. It was surprising to note the small amount of reaction in the knee-joint of the average child patient, even when the fracture was low down on the shaft. Children seem far less inclined than adults to restriction of joint motion after femoral fracture.

The ultimate function of the knee- and hip-joints and the general use of the leg cannot be stated in this series because the average stay of patients was between 6 and 8 weeks, and unaided walking had not yet been possible except in a few instances. It was our wish to have every patient leaving the hospital after this injury furnished with a walking caliper so that reductions gained by treatment might be maintained and still soft callus might not be subjected to the strain of weight bearing and muscle action. We hoped that secondary displacements and deformities might be thus avoided.

Fig 1. Battery of fracture beds. Note the simple overhead frame securely attached to the bed, in no way interfering with the floor. All weights are at the head, out of the way of passers by. The child can sit up in bed and have much freedom while the leg is in constant suspension traction in a Thomas splint.

Fig. 2. Roentgenologist making a bedside exposure. Plates taken in two planes are required. The portable X-ray is the most important factor in controlling the angle of the splint, the amount of weight used for traction, and the correction necessary for the best results.

[1] Read before the Chicago Surgical Society, November 5, 1920. (For discussion see p. 562)

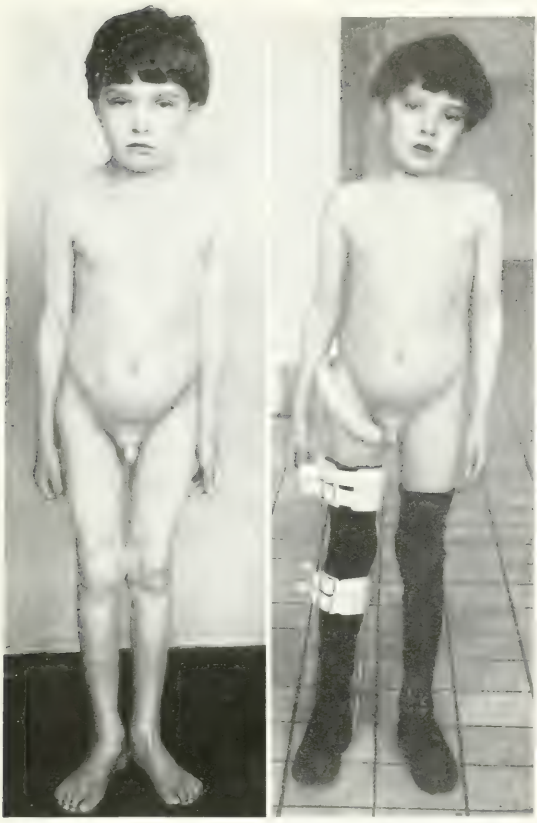


Fig. 3 (at left). Six-year old boy 5 weeks after sustaining a femoral shaft fracture. The right leg was broken; it is now slightly longer than the left, as evidenced by the pelvis tipping up on the right side. Foot position and leg axes good. Right knee a trifle swollen.

Fig. 4. Same patient 1 week later than the preceding picture, now wearing a walking caliper and able to get about briskly on crutches without danger of disturbing his still immature callus, because his weight on the right leg is borne against the ischial tuberosity.

After fracture of the femoral shaft in children under 12 years of age, callus is normally fully formed in 3 or 4 weeks. In younger children—2 to 4 years of age—it is usually formed and quite firm within 2 weeks. In our experience no child with rickets has failed to develop prompt and abundant callus. There have been no cases of non-union following diaphyseal fracture in children with rickets.

Every fractured femur in a child should be given immediate treatment; except for the treatment of shock or other more important injuries than the fracture, little can be gained by delay and much may be lost. A spreading hæmorrhagic and inflammatory infiltration of the muscles and tissues surrounding the fracture progresses rapidly. This infiltration increases the shortening already caused by the trauma resulting in the solution of the bony continuity. Every hour of delay diminishes the ease and possibility of perfect reduction by mechanical traction on a fracture table. Long continued and sufficiently powerful continuous traction may accomplish an end-to-end coaptation, but the sooner it is applied the greater the hope of satisfactory realignment.

To facilitate realignment the surgeon must use traction in such a manner as to bring the distal fragment so easily moved and controlled, into line with the proximal fragment. There is no one set of apparatus nor one angle of traction for all diaphyseal fractures. Each case is worthy of individual study and an application of the treatment peculiarly its own.

Reductions of shaft fractures apparently satisfactorily held in traction on a fracture table or any extension apparatus will not often remain in position after being encased in plaster of Paris. Plaster dries and shrinks, allowing some looseness within its boundaries and it is also quite impossible to put on a body cast or hip spica which holds strong extension in the longitudinal axis of the leg; consequently, even with a good reduction the deformity existing at the time of fracture tends to reproduce itself from muscle pull while the limb is inside the cast. A good result observed in a fresh cast today may be a poor result when studied a week hence. The powerful thigh muscles retain their contractile power while the limb is within the cast. If fragments can be interlocked, the displacement does not recur so easily so far as end-to-end apposition is concerned—but axial bowing or angularity may take place. When thigh fractures have been operated upon and fixed by internal splints, these secondary displacements are not so liable to follow, but even Lane plates attached to the femur, improperly supported by additional external splints may be bent by muscle action within the cast.

Case 27. Good final. No original displacement.

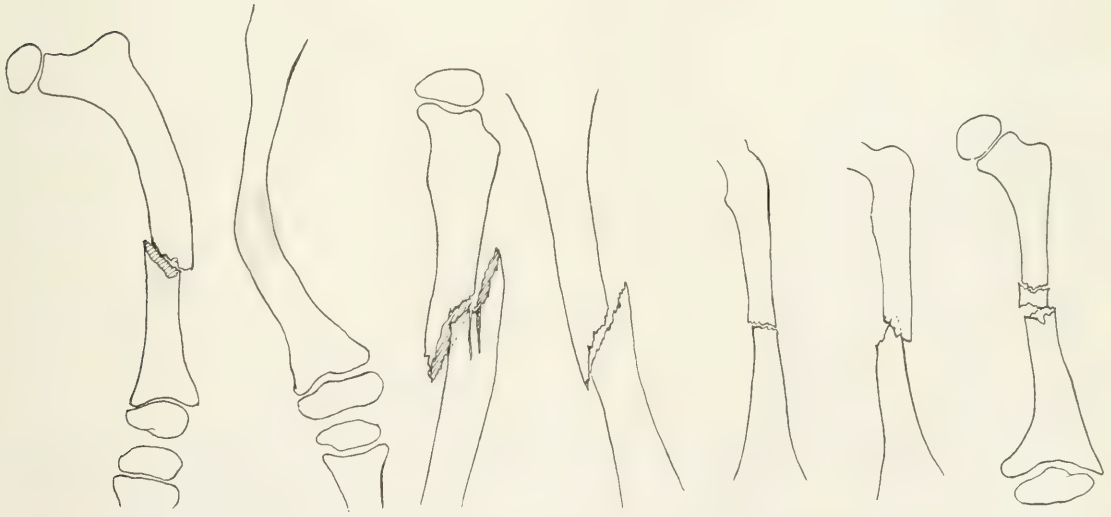
Case 9. Poor final.

Poor semifinal.

Case 34. Poor final. Note poor length, axis contact.

Case 40. First.

Poor final, 1 cm. short.



Fair after 1 month.

Case 7. Fair final, after 2 months.

First.

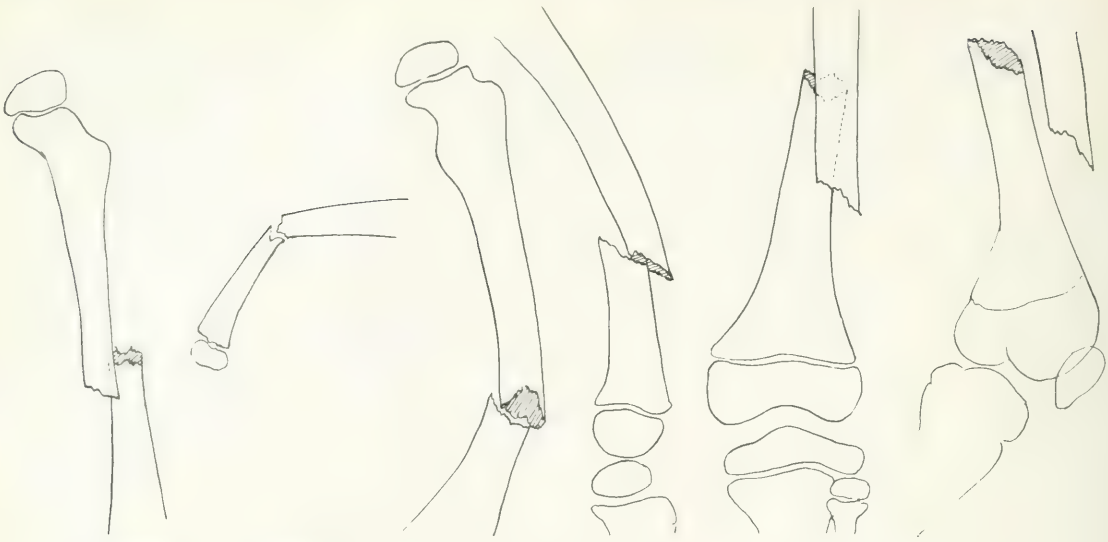
Case 42. Final, fair after 1 month.

Case 46. Very good final, 1 month.

Case 53. Fair final.

Case 47. Fair final.

Type I. Overhead vertical extension from leg to pole or frame, sometimes followed by a hip spica cast.



Case 22. Fair final. Case 36. Poor final. Case 39. Poor after 2 weeks. Poor after 1 month. Case 67. Poor after 5 weeks. Operable. Poor final.

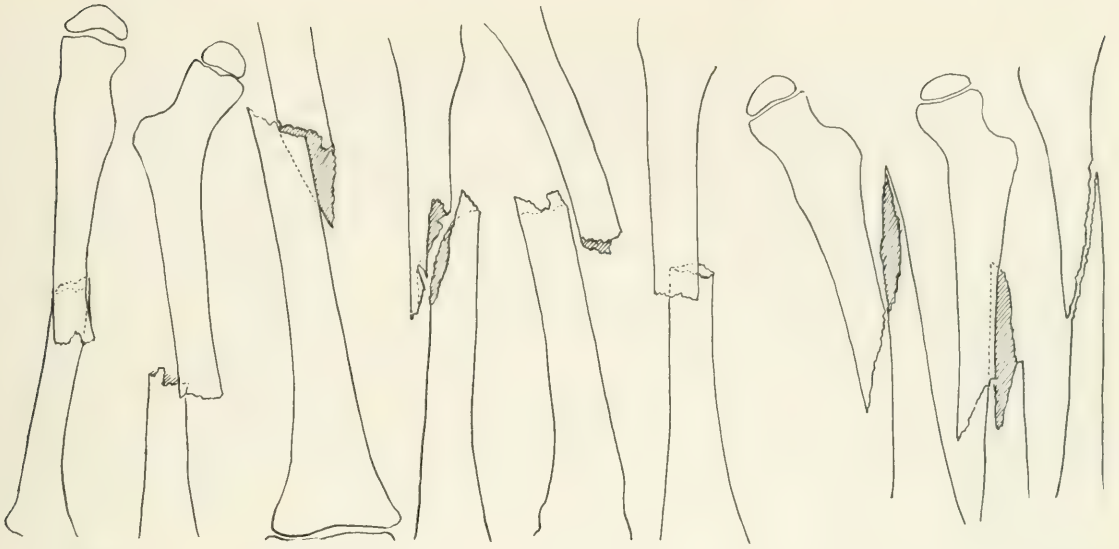
Type II. Reduction under anæsthetic (ether) followed by a splint or cast, usually the latter. No mechanica extension such as fracture table was used.

No matter what line of treatment is used up to the time of definitive callus formation, the average surgeon likes to install thereafter a plaster-of-Paris body cast or a hip spica. Few surgeons use a walking caliper to protect the soft callus from bending or shortening when the patient is freed from the cast and begins weight bearing. Most surgeons permit weight bearing too soon. Attachment of a Thomas splint without traction on the limb after callus formation while the patient is still in bed will hold reductions and is cheaper and less cumbersome than plaster. Metal splints can be used over again many times. No walking even on crutches should be attempted until a walking caliper is fitted to the patient. This should be worn when the patient is weight bearing for from 3 to 6 months after he becomes ambulatory.

The most efficient traction that can be devised may fail to give complete reduction in some instances. The surgeon must then decide to adopt one of two courses:

He can get the best reduction possible, obtain union usually with overriding, shortening, and changed axial relation of the fragments as shown by angulation. Firm bony union will usually follow. This union in a young child although far from being anatomically satisfactory may then be supported in a walking caliper and be left to nature. According to Wolff's law the bone tends to realign itself when once it is firm and is subjected to weight bearing and muscle stress so that an excellent functional result may be looked forward to in most cases. This type of result, however, demands surgical supervision for at least a year. The patient must not bear unmodified weight too soon and the union obtained must be guarded to avoid an increasing shortening or increase in the angular deformity already present.

2. The only other choice is an operative procedure. Shall a Lane plate, an intramedullary bone peg of autogenous or exogenous bone, or screws of absorbable material be used? We suggest Lane plates for the smallest proportion of fractures, usually those resulting from direct compressional violence, which are transverse or slightly oblique with overriding of 3 inches or more, and for which treatment has been delayed. If these are seen after 2 weeks, callus is already forming and no amount of external traction will effect

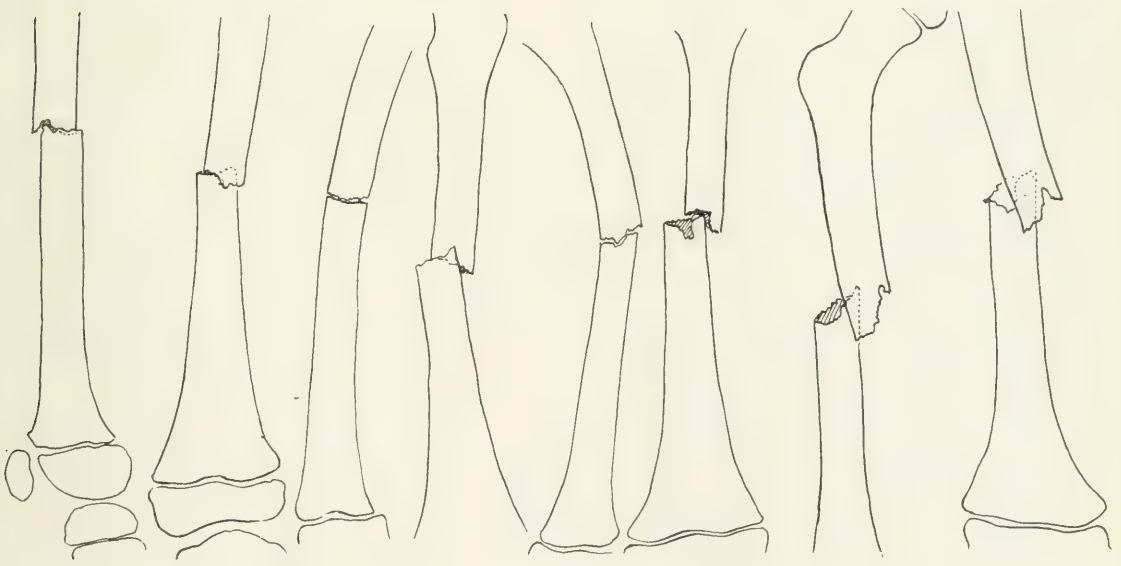


Case 21.
First, poor. Final, poor.

Case 56.
Fair final.

Case 26.
First, fair. Final, fair, after 2 weeks.

Case 44.
First. After 3 weeks, good; final after 2 months, very good.



First.

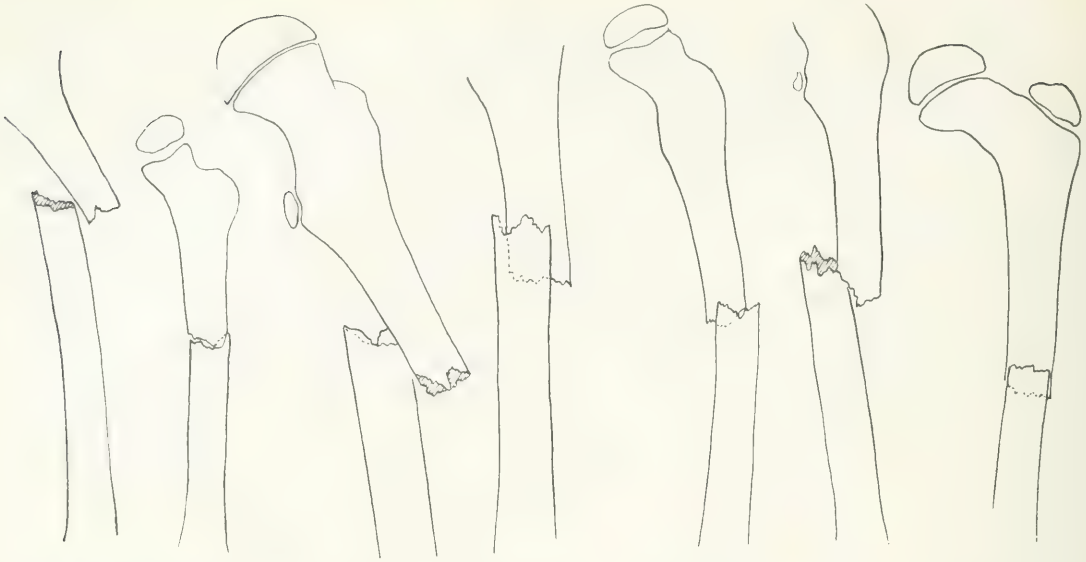
Case 54.
After 4 days in Thomas splint. Very good.

Final, after 1 month. Very good after casting.

Case 25.
Fair final.

Would have been better result if left in extension

Type IV. Early reduction attempts under anæsthesia on a fracture table, application of body plaster-of-Paris cast, the limb still under traction.

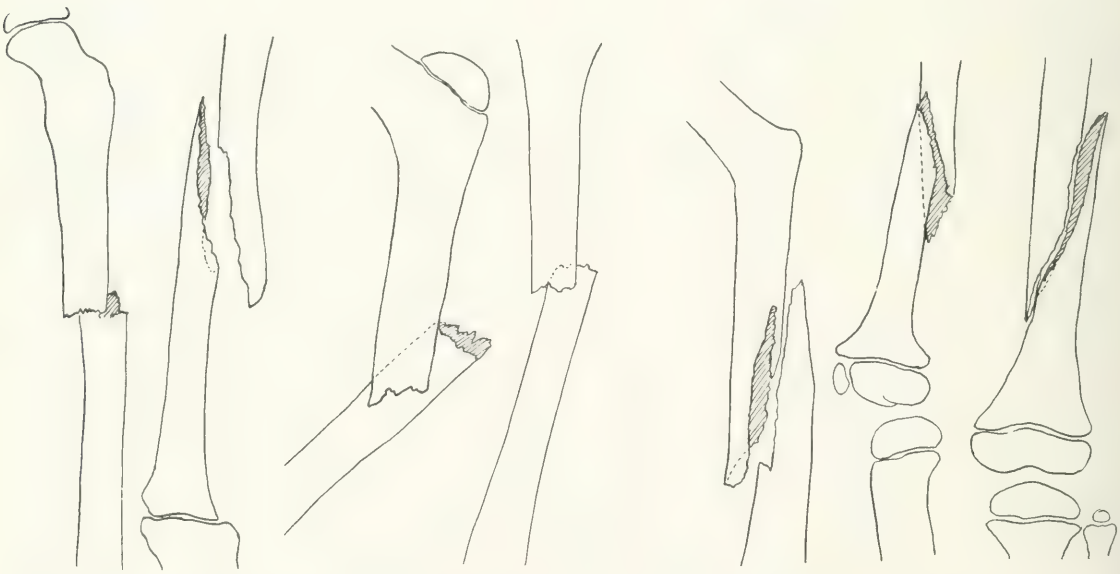


Case 48.
After reduction on Hawley table and cast. Excellent 1 month after suspension.

Case 30.
First. After 2½ weeks, good.

Case 43.
Fair final.

Case 1.
First. Final, excellent, full length.



Case 33.
Skin infected, taken down. Broke callus.

Case 8.
Final after 1 month. Fair.

Case 62.
First, poor. Poor final after 1 month.

Case 64.
First, fair. Final, fair.

Type V. Continuous suspension traction by Thomas splint and overhead frame, bringing distal fragment into line with proximal fragment for 3 to 5 weeks, followed by a plaster hip spica or splint to protect soft callus.

Case 49. Case 50. Case 51.

Final. Excellent. First. Fair final, axis poor. Could have been corrected by X-ray. First. Final, excellent after 1 month.

Type VI. Continuous suspension traction in Thomas splint by means of a caliper or nail inserted in the femur.

a reduction. All callus present must be removed before the plate is put on over the periosteum and the bone ends should be well freshened and coapted. *The plate should be removed within 6 weeks*, and a walking caliper applied to the limb to hold the reduction gained. Autogenous bone intramedullary pegs are excellent treatment when the patient has reached an age of 7 or 8 years. The operation should be performed while the patient lies on a fracture table and a carefully padded body cast must be applied before the anæsthetic ceases. A few surgeons have related to me instances of rapidly fatal fat embolism which have followed these operations. Clinically they have been of the pulmonary type and are frequently credited to pneumonia. We believe that they can be largely avoided by a careful preliminary reaming out of the medullary cavity either by a reamer or curette before a peg is driven snugly in. If a relatively large amount of the medullary fat and other tissue is left in place while a bone peg is driven for some distance into the cavity we can easily understand that the compressed and liquefied fat may find its way into the large venous blood spaces and subsequently into the general circulation. Death may be delayed for a couple of days.

Intramedullary splints of exogenous bone have not resulted so successfully in our hands. Bone and ivory screws do not often obtain successful reduction. They can be used only in spiral and long oblique fractures. The thin cortex and soft character of children's bones do not lend themselves to this method of fixation. Metal nails, screws, and even Parham's bands have some use in the internal fixation of children's bones. As a rule the fewer the operations performed on children's bones for fresh fracture the better the average results are in the hands of most surgeons. This statement does not apply to osteotomy for the correction of late deformities.

If a proper Balkan frame and suspension splint traction are used for femoral shaft fractures in children over 4 or 5 years of age, their advantages will be appreciated. There is:

1. Constant steady and efficient traction in the axis required against contracting muscles.

2. There is no pain if the skin surface does not become cut and infected and a traction

weight proportionate to the child's body weight is used.

3. The patient has bed freedom to amuse himself, to use the bed pan and to permit nursing attention.

4. A maximum length and good axial alignment can be obtained by this method if care is given to watching details.

5. Splints permitting knee movements during traction can be used. Most children do not need them. They recover quickly from any knee stiffness acquired during the 4 weeks of traction.

6. The usual result is much better than a result obtained by any other non-operative method.

After our present examination into the year's results in shaft fractures we expect to continue a routine use of suspension traction as illustrated, employing Sinclair's glue and gauze for the traction. A small percentage of the fractures will require nail extension.

When the children are younger than 4 years, the patient's total weight as compared to his limb's weight is insufficient to insure a satisfactory result by suspension traction in a Hodgen or Thomas splint. The patients are not tractable and will twist about too much. Any operation, even the insertion of calipers into the femur, is contra-indicated for the 2- and 3-year-olds. We recommend the direct overhead extension of both legs at the same time for these little people.

Should the skin on the leg of an older child break down and become infected from the traction or should the fracture be low down the shaft and a little extra extension force be required to pull the flexed distal fragment into line, calipers or nail extension are indicated. The caliper or nail must not be left in over 3½ weeks and unusual care must be taken to guard against infection. We much prefer the nail extension. It cannot slip out and should never lead to infection. All splints, dressings, extensions, ropes, pulleys, and weights must be inspected at least twice daily.

The most important controlling factor we reserve for the last. That is the use of the portable X-ray tube for control of the position gained by traction. The roentgenograms should be made within 48 hours after the leg has been established in suspension traction. When the traction is insufficient, when bowing or angularity or incorrect axial relation exists the plate shows the error and simple steps taken early in the course of healing may bring perfect results. Splints may be bent and weights adjusted to fit each patient. Don't put off taking the roentgenogram until callus has formed which is too strong to prevent the corrections necessary for a happy outcome.

ANALYSIS OF THE RESULTS OF TREATMENT OF FRACTURES OF FEMORAL DIAPHYSIS IN CHILDREN UNDER 12 YEARS OF AGE

Total number of patients, 67; 21 females, 46 males

Age	*Cases*	*Age*	*Cases*
Under 1 year	1	6 to 7 years	6
1 to 2 years	13	7 to 8 years	7
2 to 3 years	7	8 to 9 years	5
3 to 4 years	5	9 to 10 years	6
4 to 5 years	7	10 to 11 years	3
5 to 6 years	4	11 years	3

Average age, 5 years

Method of Treatment	Results	Cases
I. Overhead vertical extension from leg to pole or frame, sometimes followed by a hip spica cast	Very good	3
	Good	6
	Fair	9
	Poor	7
II. Reduction under anæsthetic (ether) followed by a splint or cast, usually the latter. No mechanical extension such as fracture table was used.	Very good	1
	Good	1
	Poor	4
III. Old fashioned Buck's extension generally followed by cast after callus formation.	Poor	3
IV. Early reduction attempts under anæsthesia on a fracture table, application of body plaster-of-Paris cast, the limb still under traction.	Very good	1
	Good	1
	Fair	1
	Poor	5
V. Continuous suspension traction by Thomas splint and overhead frame, bringing distal fragment into line with proximal fragment for 3 to 5 weeks, followed by a plaster hip spica or splint to protect soft callus.	Excellent	2
	Very good	2
	Good	5
	Fair	6
	Poor	2
VI. Continuous suspension traction in Thomas splint by means of a caliper or nail inserted in the femur	Excellent	2
	Very good	1
	Fair	2
	Poor	1
	Total cases treated	67

Excellent—100 per cent reduction in length and in both axes.
Very good—100 per cent reduction of either length or axes; other factor good.
Good—satisfactory length of axes; nearly so in other factor.
Fair—satisfactory length of axes; other factor not satisfactory.
Poor—neither length nor axes satisfactorily reduced; fair to good functional use promised in many cases.

NOTE.—Much improvement could have been expected in the average result under suspension traction (V) if more attention had been given to watching details. A frequent change of house surgeons during the last year has led to some confusion. I am indebted to my present house surgeons, Drs. Lowry and Davison, for their unflagging interest in obtaining results.

THE INFLUENCE OF SYPHILIS UPON THE PREGNANT WOMAN

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

WHEN we speak of syphilis in pregnancy, we habitually think only of the dangers that may threaten the unborn child. That the mother, too, may come to harm, is almost altogether left out of consideration. Such, at least, is the impression one gains in reading the textbooks on obstetrics. Yet, one has but to collect scattered reports from literature to realize that the combination of syphilis and pregnancy may mean a real risk to the childbearing woman, and one will hardly go far from the truth in assuming that not all such instances have found their way into print.

SYPHILIS AND PREGNANCY

The subject is usually disposed of by the statement that syphilis in pregnancy "runs its ordinary course." That is undoubtedly true of a very large percentage of the cases. A latent syphilis may even persist throughout pregnancy without giving rise to any manifestations until the birth of a syphilitic child directs attention to the disease in the mother. But I do not recall a single syphilitic gravida who would have enjoyed that exuberant feeling of good health, that blossoming out into an intensified well-being which we so often find in normal women during pregnancy. On the contrary, the ordinary subjective discomforts of the pregnant state appear often in an aggravated form in syphilitics. In addition, such women frequently complain of headache, loss of hair, insomnia, and obstinate neuralgias in various parts of the body; they are anæmic, lose weight and have more or less persistent fever—all symptoms which to the watchful observer or in the retrospect are indicative of the disease. One of my patients who had passed through a symptomless gestation until the death of her child 3 days after delivery revealed the diagnosis of syphilis, suffered throughout pregnancy from intense headache which was falsely attributed to a hereditary migraine that had troubled her from childhood on. She received antiluetic treatment, and her two subsequent pregnancies have been singularly free from her former distress. Taussig reports an instructive case in which persistent high fever of obscure origin furnished the indication for induction of premature labor. Only after delivery was the syphilitic nature of the hyperpyrexia recognized from the instantaneous effect of mercury injections.

This augmentation of subjective symptoms runs parallel with an intensification of local manifestations. Cutaneous eruptions are, perhaps, not more pronounced nor more protracted than in the non-pregnant state, but lesions of the mucous membranes, particularly in the genital sphere, appear decidedly stimulated. The physiological succulence of the tissues during pregnancy is the obvious explanation. Thus, primary lesions are larger and more persistent than ordinarily seen in women. The ephemeral nature of chancres in women as contrasted with those in men, is well known. In pregnancy, however, the conditions are changed. Of eleven chancres of the vulva, studied by Certanesco, only one lasted less than a month, the average duration was 2 months and 21 days, and in one case, the lesion persisted as long as 8 months. Condylomata lata increase in size and number; and the swelling of the glands makes rapid progress and not infrequently terminates in suppuration. "Eroded papules," says Fournier, "develop with a singular exuberance, take on quickly granulating appearance, hypertrophy, and often constitute veritable tumors which invade and deform the entire vulva. Further, they are always more rebellious to treatment, being reabsorbed slowly and with difficulty. The ulcerating syphilides are very frequent in pregnant women, are livid, purple, and excavated, which condition is increased by the general tumidity of the parts. They persist longer and have a tendency to become phagadenic." The destructiveness of these lesions in preg-

nancy is well illustrated in Marschner's case (see collection of case reports).

Winckel found manifestations upon the external genitals in 99 out of 252 syphilitic gravidæ, which indicates a much greater frequency than in non-pregnant women. The reappearance of luetic lesions in pregnancy after a more or less prolonged stage of latency has been noted by several authors (Winckel, Doléris, Rille, Augagneur, Zweifel).

There is yet the well-established influence of syphilis on the general constitution to be considered. One has but to glance through any textbook on internal medicine to be impressed with the multitudinous harm that syphilis may inflict upon the various organs of the body. Heart, lungs, and liver, the gastro-intestinal tract and the cerebrospinal system—in short every part of the organism may either become the seat of a specific disease or be weakened in its physiological functions.

On the other hand, it is equally well known that pregnancy makes very high demands even on a healthy organism—demands with which the marvelous elasticity of the human body is not always able to cope successfully. The difficulty of overcoming the various toxæmias of pregnancy is still more marked in those cases in which vital organs are weakened or diseased prior to conception. These are the cases in which, in pregnancy, the tuberculosis of the lungs makes rapid progress, where the circulatory apparatus is unable to do its work, the kidneys fail to function properly, the nervous system succumbs, or disturbances of endocrine glands, such as exophthalmic goiter or tetany, are exaggerated beyond control.

If we now bring into relationship the considerations touched upon in the two preceding paragraphs, it does not seem too far fetched, to think that the combination of syphilis and pregnancy may, after all, not be a negligible quantity as far as the woman herself is concerned, that, *because of their syphilis*, such patients may be exposed to dangers to which heretofore no thought had been given. It certainly seems strange that this cause and this course of pathological physiology in pregnancy have thus far escaped attention altogether, and it should, in my opinion, be a very thankful task for an obstetrical and a medical clinic working conjointly to throw light upon this obscure subject. Then, perhaps, shall we learn why certain cases of diabetes, of nephritis, of cardiac disease in pregnancy do not respond to appropriate treatment.

It has, indeed, been claimed that, in some cases, eclampsia may be due to syphilis; and we should seriously consider the assertion by Magalhães that in toxæmias of pregnancy anti-luetic treatment, if instituted early, gave excellent results.

As a general proposition, according to Petit, the morbidity of pregnancy is reduced the sooner and the more systematically specific treatment is instituted.

SYPHILIS AND LABOR

The labors of syphilitic women may be perfectly normal and differ in no wise from those of healthy women. Yet, exceptions are rather too frequent to deserve only a passing mention. Bettmann is mistaken when he states that any such complications have been noted by syphilologists rather than obstetricians.

Abnormal presentations are comparatively common because the fœtus is either premature or macerated. But even when the pregnancy has gone to full term and the position of the child is normal, weak contractions have been recorded by numerous authors. This insufficiency of the uterine muscle will be found recorded in several of the cases collected below. Magalhães states that two of his patients who had primary inertia in previous deliveries, had normally strong contractions in subsequent labors after having received specific treatment.

Still more unfavorable is an occasional abnormal resistance of the cervical tissues. In the non-pregnant state, chancres or secondary ulcerations usually lack the typical induration. This seems to be essentially different in pregnancy. Tissue changes are much more pronounced: œdema and induration are marked, and endarteritis and periarteritis are intensified. There is an increased proliferation of connective tissue and a

sclerosis in the surroundings of the vessels. A number of the authors liken the consistency of the cervix to that of wood, and in LeBigot's case one of the examiners, on palpating the cervix, thought at first that he was touching a pessary. Even after the healing of the local lesion, the alteration of the structure is such that the sclerosed cervix cannot readily be effaced, nor the external os be dilated. No wonder, then, that Blandin, in his case, anticipated dystocia or that Rille, Hiridoyen, Magalhães, and others actually observed interference with labor from such a rigidity of the cervix.

Occasionally, the hardened cervix will yield, though very slowly. Usually there is premature rupture of the membranes which still further delays dilatation. In Martin's observation, a young primipara with a normal pelvis was in labor almost 32 hours before the constriction at the external os gave way to the regular and violent contractions of the uterus. A living child was born spontaneously, but the cervix showed a deep tear. Doléris records the case of a woman of 24 whose first delivery was perfectly normal; the second labor, though premature, lasted 20.5 hours due to the rigidity of the cervix resulting from a chancre. Here, too, the cervix was torn deeply. Magalhães has seen a case of complete spontaneous amputation of the cervix in labor because the rigid tissues could not be stretched.

Operative intervention becomes necessary in these protracted cases when the mother is exhausted or the fœtal heart beats are feeble. Thus, Putegnat had to apply forceps in four cases (No. 17, 18, 19, 20), three of which were premature, and all four children died either in labor or soon afterward. Rémy waited several days before he used forceps; the child lived but the mother died from puerperal infection.

The majority of authors seems to have resorted to cervical incisions to terminate labor. Under the peculiar circumstances, such incisions were not at all easy to make. LeBigot tells of Chiara whose scissors would not cut through the fibrosed tissues. Other authors had to use bistouries. As many as eight incisions had to be made in several

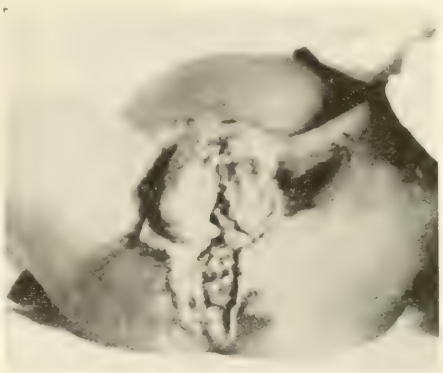


Fig. 1. Photograph showing enormous tumor in author's second case.

instances. In some, the incisions had to be deepened or additional ones made before the fœtus could be delivered. Putegnat (No. 16) turned and extracted the child; the mother died during the operation. Most of the other authors applied forceps after the incisions. In Fasola's case, the first delivery was normal. The second child weighed only 1500 grammes, but after 48 hours of labor a cervical incision and forceps were needed to deliver it. The cases of Blanc, Chiarleone, LeBigot, and Welponer had a normal puerperium. Férouelle's patient died from sepsis, while in Mesnard's case, the woman had an infection but recovered eventually. Oui performed a vaginal cæsarean section and lost his patient 3 days after the operation. Champétier de Ribes and Magalhães did abdominal cæsarean sections with success.

An obstacle to delivery may be present at the vaginal outlet if the vulva is the seat of a syphilitic granuloma, a voluminous tumor exhibiting, together with the irregular projections, deep fissures, and necrotic ulcerations, that curious elastic resistance which renders it so unique among genital tumors. I have observed two such cases in labor which, however, terminated quite differently from one another.

The first case is that of a colored primipara, age 30 (Petona H. No. 313-1920), in whom the vulvar granuloma had the size of more than a man's fist. The vaginal entrance was narrowed and rigid, yet after 5 weeks of potassium iodide and mercury by

mouth, the indurated tissues became considerably softened for, on June 9, 1920, she gave spontaneous and easy birth to a living child of 8 pounds, practically without laceration.

Such a favorable outcome was, unfortunately, absent in the second case. Rose J., colored, age 38, (No. 1383-1919) had been admitted to the City Hospital and other institutions in this city a number of times in the last 5 years on account of an enormous syphilitic granuloma of the vulva which resisted every form of treatment. Wassermann test remained positive in spite of numerous injections of salvarsan and mercury and massive doses of potassium iodide, and the tumor grew steadily in size and extent. I saw her first early in May, 1919, when she was in the eighth month of her first pregnancy. She then had a saddle nose and a perforated palate in addition to numerous old syphilitic scars over her body. The accompanying photograph gives but an inadequate impression of the enormous tumor mass which occupied the vulva and perineum and extended far back into the gluteal fold involving the rectum and impairing the sphincteric action. A copious dirty brownish secretion with an intolerably foul odor filled the deep crevices of the furrowed protuberances and fistulous tracts of the indurated ulcerations and made any attempt at cleanliness illusory. The vaginal entrance was constricted to such an extent that one finger only could be inserted with difficulty.

The impossibility of delivery through the natural passages was so obvious that cæsarean section at term was decided upon. In the meantime, large doses of potassium iodide and daily mercury inunctions were prescribed. She left the hospital early in June, but came back in a few days as weak contractions of premature labor had set in. Cæsarean section was performed by a member of the house staff. The operation was done swiftly and correctly, but the child was dead, and the mother, too, died within 3 days with symptoms of sepsis.

Where only condylomata lata occupy the vaginal outlet, friability of the perineum may be pronounced. Such lacerations occurred in three of DeLee's cases "the head bursting through the vagina, tearing it in all directions like wet paper." The same happened in one of Hiridoyen's cases. On the other hand, Winckel emphasizes that in his 3 cases of broad condylomata on the vulva, only small lacerations occurred.

Perineal tears occasioned by the presence of luetic lesions, should not be repaired. I quite agree with Wells that it is useless to suture the wounds; it is preferable to let them heal by granulation and to attend to them only after a successful antisyphilitic treatment.

A unique birth injury occurred in the case reported by Dorsett. An old syphilitic stricture of the rectum had resulted in the dilatation and weakening of the bowel above, and the pressure of the downcoming head caused a tear in the rectal wall with consecutive fatal peritonitis.

Of other rare complications, Martin, Magalhães, Zweifel, and Weber have reported cases of spontaneous rupture of the uterus. Hydramnios was present in one of Hiridoyen's cases, as well as in the first of my cases, recorded above. Bovée and Bitschin call attention to syphilis as one of the causes of premature detachment of the placenta. Jaschke cites several cases of rupture of the heart as a result of syphilitic sclerosis of the coronary arteries or of gumma in the heart muscle. The sudden and sharp rise of blood pressure in labor is, in such cases, responsible for the catastrophe. I wonder whether some of the "unclassified" cases of sudden death in childbirth do not fall in this category. Aneurism may occur in the uterine artery, as in other vessels, as a result of syphilis. According to Jaschke, Dauter, Hewitt, Kuestner and Vogelsanger have reported cases of rupture of such aneurysms in labor with severe and even fatal hæmorrhages. Magalhães, whose excellent paper has repeatedly been cited in the foregoing, speaks of the complications that may arise from a syphilitic hydrocephalus, and he expresses his belief that certain cases of death in labor are due to the effect of syphilis upon the adrenal system which becomes exhausted.

Briefly summarized, the potential danger from syphilis in labor is definitely established. A number of cases have been quoted where previous deliveries had been normal but where an intercurrent syphilitic infection caused serious complications. On the other hand, Magalhães points to his observations that syphilitic women who previously had difficult or prolonged labors, experienced normal confinements after having received specific treatment.

SYPHILIS AND THE PUERPERIUM

Winckel claims that there is no particular morbidity and no mortality from syphilis

in the puerperium, though he adds that subinvolution, persistence of bloody lochia, and delayed recovery of the patients, are frequently observed. Only one of his patients had a postpartum hæmorrhage. Hiridoyen, too, believes that syphilis exerts but little influence upon the puerperium though he himself had, among 34 cases, two of adherent placenta with serious hæmorrhage.

These conservative views which are shared by DeLee and others are undoubtedly correct in the majority of instances, yet, the deviations from the general rule call for caution. Postpartum hæmorrhages have already been mentioned. Tripaut's report must be adduced in this connection.

But the greatest danger lurks in infection. Jaeger very justly calls attention to the fact that, after the birth of macerated fœtus, membranes are frequently retained. Such patients are apt to have fever and fœtid lochia. Even if there are no local lesions about the internal or external genitals, the chances of an infection are increased, perhaps because the resistance of the organism of a syphilitic is lowered. Hence, internal examination in labor should be restricted to a minimum and great care should be exercised in the puerperium.

In most of the cases collected below puerperal infection occurred which could not always be combated with success. Létulle demonstrated the post mortem findings in the uterus of a syphilitic, and the celebrated case of Hoffmann proved that chronic and fatal sepsis may be due solely to syphilitic changes of that organ.

In the general run of cases the final outcome is probably not so serious. The consensus of opinion is that syphilitic parturients, with or without local lesions, are apt to have subinvolution because the affected uterine muscle cannot contract sufficiently and protect itself against germs. And as subinvolution is a recognized source of various and sundry gynecological ailments, we encounter here syphilis as a prolific etiological factor of gynecological pathology. The usual treatment of subinvolution fails in this class of cases, but Magelhães has seen quick involution by mercury and neosalvarsan in 18 out of 20 cases, and has thereby established specific therapy as an excellent prophylactic measure in gynecology.

SUMMARY AND CONCLUSIONS

Discussions on syphilis in pregnancy have, in the past, been limited almost altogether to the harm that may befall the unborn child; and most of the textbooks on obstetrics convey the impression that the mother has nothing to fear from the disease. While this is true of a very large percentage of the cases, the writer has attempted to show from personal observations and a review of the available literature that syphilis is capable of producing real complications—whether in pregnancy, by impairing the general health of the patient, or in labor by obstructing the birth passages or causing other more or less serious damage, or else in the puerperium by adding to the morbidity and mortality of that state. And who is there to tell just when any of these complications may arise in a given case, or to what extent they may endanger the patient's life? The very uncommon personal observation recorded by the writer above, sounds an additional note of warning.

The practical conclusion is very obvious. Knowing that *both* mother and child are endangered, we must ever bear in mind the possibility of syphilis, particularly when we have to deal with obscure recalcitrant disturbances in pregnancy, and once our diagnosis is made, we must give energetic and systematic treatment to such women throughout the period of pregnancy.

COLLECTION OF CASES REPORTED

Case 1. Reported by Blanc, Lyon méd., 1891; Arch. de tocol. et de gynéc., Par., 1891; abstracted Zentralbl. f. Gynaek., 1891, xv, 981. The first labors of this patient had been very easy and rapid. In her third labor, a syphilitic induration due to a hard chancre on the anterior lip became an obstacle to delivery and required multiple incisions after 17.5 hours of strong and regular contractions. Forceps. The cachectic child died after a few days.

Case 2. Reported by Blandin, Obstétrique, 1902, vii, 43. In a woman pregnant 8 months and presenting numerous syphilitic manifestations, an extensive, indurated ulceration of the cervix was discovered. Its base was irregular, its contour fairly well marked. Blandin anticipated dystocia from the rigidity of the cervix.

Case 3. Reported by Champétier de Ribes, cited from Férouelle, Thèse de doct., Par., 1902. Primipara age of 27; secondaries in the eighth month of pregnancy. Upon the vaginal portion, about halfway between the external os

and the vaginal fornix, there is an indurated tumor of the shape of a crescent, in the concavity of which there is an ulceration with a yellowish base and a sharply defined red contour. The induration of the base resembles that of cartilage. Patient went into labor at full term, but dilatation did not occur in spite of 4 days of strong contractions; on the contrary, the rigidity of the external os seemed to increase and the induration, which had occupied only the anterior circumference of the cervix, appeared more extensive. In view of the unfavorable results of cervical incisions in the presence of syphilitic lesions, abdominal cæsarean section was performed and a living child extracted. Afebrile convalescence.

Case 4. Reported by Chiarleone, Ann. univers. di med., Milan, 1873, quoted by Le Bigot. Primipara, age 22; 7½ months pregnant; infection about 2 months previously for which she had received specific treatment for about 2 months. Labor near term. Diagnosis of twins. Œdema and induration of vulva and cervix were present. Contractions were weak and premature rupture of membranes occurred. Multiple incisions were made after about 36 hours; finally forceps were used on first child; second child born spontaneously. Deep perineal lacerations. Normal puerperium.

Case 5. Reported by Doléris, Arch. de tocol. et de gynéc., Par., 1885. Woman age 24, with a normal pelvis, whose labor, 4 years previously, had resulted in the spontaneous birth of a living child. In the eighth month of her second pregnancy there were marked secondaries over all of the body; condylomata lata and ulceration of vulva. The cervix was large and hard and about 3 centimeters long. The anterior lip which was even harder than the rest, was the seat of an ulcerated tumor the size of a hazelnut, "beyond doubt, a chancre." The vagina was filled with a mucopurulent, offensive discharge. Well developed hydramnios was present. Local and general antisyphilitic treatment caused prompt disappearance of all specific manifestations; the tumefaction of the cervix, too, retrogressed, but the rigidity remained. Six days after the treatment had been instituted, premature labor pains set in, but in spite of strong and regular contractions, the cervix yielded but very slowly, and complete dilatation occurred only after 20.5 hours. There was spontaneous birth of a living child which, 8 days later, presented signs of lues. There were deep bilateral tears of cervix. Puerperium was normal. Under continued treatment, all lesions disappeared.

Case 6. Reported by Dorsett, Surg., Gynec. & Obst., 1920, xxx, 283. A multipara, age 37, had been delivered by forceps 30 hours prior to admission to hospital. Death resulted from peritonitis. At autopsy, a rupture of the rectum at the rectosigmoidal junction and above an old syphilitic stricture of the rectum was found.

Case 7. Reported by Fasola, Ann. di ostet., 1886; quoted from Le Bigot. II-para, age 20; first confinement normal; now pregnant 7 months. Patient showed marked secondaries. Membranes ruptured 2 days previously. The cervix was dilated 3 centimeters, but was hard, thick, and tight around head. No progress was made after 46 hours in spite of frequent and strong contractions. One deep cervical incision was made. Forceps were used and a living child, weighing only 1500 grammes delivered. Puerperium was normal.

Case 8. Reported by Férouelle, Thèse de doct., Par., 1902. III-gravida, age 22, very poorly nourished, with copious bloody and purulent vaginal discharge. There were three indurated ulcerations ("chancres") at the vulva. Cervix was large and hard; the cervical lips gave to the examining finger the sensation of cartilage. Speculum examination revealed an extensive ulceration of the vaginal portion which extended into the cervical canal. After 32 hours of labor, dilatation was still incomplete due to the unyielding rigidity of the os. Cervical incisions were made. With forceps a living, slightly asphyctic child was extracted. Death of the mother from puerperal sepsis occurred 11 days after confinement.

Case 9. Reported by Hoffmann, Ztschr. f. Geburtsh. u. Gynaek., 1911, lx, 482. Patient admitted to hospital with chronic sepsis subsequeut to the delivery of living twins 2 months ago.

High fever. Wassermann positive. Below urethral opening there was an ulcer with fatty, glistening surface, a smaller round ulcer at fourchette. On anterior cervical lip was a tumor, the size of an apple, necrotic, with ulcerated surface, also waxy in appearance. On the right side was an island of intact mucosa within the ulcerated area. Uterus was irregular, greatly enlarged, movable, not tender. Right appendages were enlarged and adherent; left adnexa and parametrium seemed normal. Microscopic examination of excised piece of cervical tumor showed a syphilitic gumma. Patient died 4 weeks later as the result of the chronic sepsis. At autopsy a thick layer of gummatous tissue was found, several centimeters in thickness, reaching from the vaginal portion to fundus and involving the entire endometrium and penetrating deeply into the myometrium. Right tube and ovary were transformed into a gummatous mass. All the retroperitoneal glands, especially around right ureter, were changed into gummata. Several gummata were present in liver, one in lungs.

Case 10. Reported by Le Bigot, Thèse de doct., Par., 1899. Woman, age 30, had a normal delivery of a living child 2 years previously. Syphilitic infection developed at beginning of second pregnancy. Early secondaries were present on skin and vulva. Cervix was long, closed, and of the consistency of wood. An examining physician thought at first that he was feeling a pessary. Speculum examination showed cervix reddened, œdematous; on posterior lip an ulceration with grayish base, coated with pseudo-membranes. Specific treatment was instituted. Labor set in 6 days later. Cervix was no longer "ligneous," but was still hard. Only very little dilatation was present after 12 hours of regular contractions; then secondary inertia. No progress was made after another 7 hours. Hot douches were given, four incisions were made and still there was very little progress. A very hot *intra-uterine* douche revived the contractions only for a short time. Occasionally there was complete cessation of contractions. The incisions were deepened. Finally, after a total of 54 hours, there was complete dilatation and a living child weighing 2,170 grammes was born spontaneously. Puerperium was normal. Treatment continued.

Case 11. Reported by Létulle, Bull. de Soc. anat., Par., 1906, lxxxi, 724. Demonstration of a uterus from a syphilitic woman who had died 28 days after childbirth. The veins in the subserosa showed the manifestations of a proliferating endophlebitis.

Case 12. Reported by Marschner, Tr. Gynec. Soc., Dresden, 1900; Zentralbl. f. Gynaek., 1900, xxiv, 702. III-gravida; two confinements, four abortions; no signs of syphilis in present pregnancy. Potassium iodide was given prophylactically in third month, yet extensive luetic ulcerations on perineum and labia appeared a few weeks later. In spite of mercury by mouth, there was rapid destruction of labia, vagina, and perineum. Local applications of mercury and very large doses of potassium iodide brought about a temporary cure. Dead child was born prematurely. The destructive process returned 6 months after labor.

Case 13. Reported by Martin, Normandie méd., Rouen, 1896. Primipara, age 20, at term, with living child

in vertex presentation; pelvic measurements normal. Old initial sclerosis was present on major lip, and hard œdema of lower circumference of vulva; roseola on trunk and legs; swollen inguinal glands. The membranes had ruptured prematurely, prior to entrance in hospital. Internal examination showed the cervix effaced. The external os represented a thick, hard ring, barely admitting two fingers. This condition persisted for almost 32 hours despite regular and violent contractions. Finally, there was spontaneous birth of a living child with a deep tear of the cervix and a second degree laceration of the perineum. Diagnosis: syphilitic (secondary) rigidity of cervix.

Case 14. Reported by Mesnard, Arch. de tocol. et de gynéc., Par., 1891; abstracted, Zentralbl. f. Gynaek., 1891, xv, 842. First pregnancy, 1.5 years previously, terminated in a miscarriage of 2 months. Secondaries were marked. Present (second) pregnancy at full term. Under strong contractions, the cervix was effaced but the os did not dilate. The edge of the os was lined with numerous hard nodules. After 27 hours of labor, membranes ruptured, but dilatation did not occur. As the child's life seemed in danger, 8 incisions were made into the cervix and forceps were applied. Patient had a puerperal infection, but recovered eventually.

Case 15. Reported by Oui, Semaine gynéc., Par., 1913, xviii, 325. Primipara, age 22; delivered prematurely by means of vaginal cæsarean section on account of rigidity of cervix. Patient was in secondary stage of syphilis and died 3 days after operation; the child died 44 hours after birth. Autopsy showed the cause of death to be renal and hepatic insufficiency. Section through cervix showed chronic sclerotic inflammation, in places hyaline degeneration. A small fibrous node on cervix.

Case 16. Reported by Putegnat, Bruxelles, 1871; quoted by Le Bigot. Woman, age 27, in the seventh month of her first pregnancy, had been in labor for the past 11 days. Os size of a two franc piece; edge hard and from 1 to 2 centimeters in thickness, ulcerated, bleeding. Two cervical incisions were made. Dead child delivered by version and extraction. Patient died during the operation.

Case 17. Reported by Putegnat, Bruxelles, 1871; quoted by Le Bigot. Woman age 29, pregnant 8 months; chancre on anterior lip; numerous condylomata lata on vulva and perineum. Forceps were applied after 16 hours, because of exhaustion of patient. Child died 3 days later.

Case 18. Reported by Putegnat, Bruxelles, 1871; quoted by Le Bigot. Woman in eighth month of pregnancy. Feeble and infrequent contractions were present. Ulcerated chancre was found on right side of vaginal portion. Forceps were used. Child died on fourth day.

Case 19. Reported by Putegnat, Bruxelles, 1871; quoted by Le Bigot. Primipara of 19, with indurated syphilitic ulceration on posterior lip and on right side. Forceps were applied after about 25 hours. Child stillborn.

Case 20. Reported by Putegnat, Bruxelles, 1871; quoted by Le Bigot. Primipara of 24, 8.5 months pregnant; large chancre on posterior lip. Forceps. Child died 2 days later.

Case 21. Reported by Rémy, Rev. méd. de l'est, 1896. Primipara, age 26; initial sclerosis on major lip; condylomata lata on vulva. Premature rupture of membranes occurred, and 2 days later, in spite of regular and strong contractions, the cervix was still 0.5 centimeter long and of a cartilaginous consistency. After another 47 hours, the cervix was effaced, but the os admitted only two fingers and was very hard and thick. During the following 36 hours, contractions ceased from time to time and even though incisions were made several times, the os dilated very slowly. Finally high forceps were applied and a living child was easily extracted. The mother died from puerperal infection.

Case 22. Reported by F. J. Taussig, Surg., Gynec. & Obst., 1916, xxiii, 274. A woman, age 23, had received antiluetic treatment about the middle of her pregnancy. When seen by Taussig, she had developed a fever which ran as high as 103.5° and persisted for 2 weeks. Typhoid, tuberculosis, pyelitis, sepsis, and appendicitis could be excluded. Premature labor was induced but the fever rose still higher after delivery. Then the possibility of syphilis was considered and two mercurial injections were given after which the fever ceased at once and did not return.

Case 23. Reported by Tripaut. Semaine méd., 1895, May 11; quoted from Barthélemy, La Syphilis. Postpartum hæmorrhage was treated unsuccessfully by rest in bed, hot douches, three curettages, and uterine drainage. Hæmorrhages continued. Tripaut considered the necessity of vaginal hysterectomy when he learned that patient had had a syphilitic infection 9 years previously. Although there were at present no evidences of such an infection, antiluetic treatment was instituted. After 10 days patient was much improved. Hæmorrhages ceased after 6 weeks.

Case 24. Reported by Welponer, Zentralbl. f. Gynaek., 1881. III-para, age 24, had been in labor 48 hours. Specific tumors were present on the cervix and posterior vaginal wall. Five incisions were made to apply forceps; others to extract the living child. There were deep cervical tears. Lochia remained bloody for a long time.

Since the foregoing article was written several publications have appeared which have a direct bearing on our subject.

Cron, Am. J. Obst. & Gynec., 1920, i, 278, reports the case of a primipara with diabetes mellitus due to syphilitic pancreatitis. An appropriate diet and repeated salvarsan injections held the glycosuria in check but could not prevent the fœtus from being expelled prematurely. During the puerperium, the diabetes could be controlled temporarily by a lowering of the carbohydrate intake and antiluetic treatment, but returned eventually when a peritonitis supervened which was due to a ruptured tubo-ovarian abscess of gonorrhœal origin. This peritonitis caused the death of the patient.

Weibel, Zentralbl. f. Gynaek., 1920, xliv, 1103, mentions the case of a VII-gravida with a syphilitic aortitis who suddenly died in the latter part of pregnancy without any premonitory symptoms.

Bartholomew, Am. J. Syphil., 1920, iv, 725, records a case of syphilitic ulceration of the vaginal vault and cervix complicating pregnancy at the eighth month, but cured by antiluetic treatment and followed by normal labor at full term.

Grassmann, finally, Deutsche med. Wchnschr., 1920, xlvi, No. 26, describes a cervicovaginal fistula which had developed in a primipara of 22 years in the course of an abortion. The uterus was found in pronounced anteflexion and the cervix and external os exhibited an abnormal rigidity due to syphilis. In connection with this observation, the paper by Neugebauer, Zentralbl. f. Gynaek., 1902, xxvi, 820, must be cited. His cases as well as those of Nordmann and Piering make it appear plausible that a syphilitic ulceration upon the posterior wall of the cervix may so weaken the latter that the fœtus may be forced through a cervical fistula if the pathological rigidity of the rest of the cervix opposes too great a resistance to natural birth.

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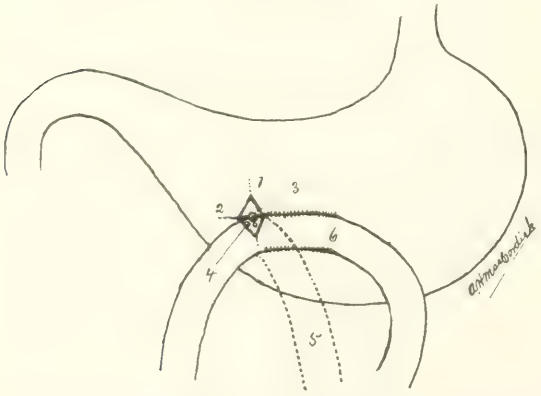
RECURRENT GASTRIC PERFORATIONS

By CHARLES K. P. HENRY, M.D., C.M., F.A.C.S., Montreal

RECURRENT gastric perforations are by no means unusual, and every surgeon can record several cases where two or three such have occurred in a single case. A perusal of the literature has so far resulted in my failing to find a case where five perforations have occurred in a single case, with five operations and recovery.

The case reported shows the importance of the silk or linen suture in possibly causing recurrent perforations.

Mr. Charles H., white, age 36, a window-dresser, was admitted to the Montreal General Hospital, case number S-227, service of Dr. J. M. Elder, February 19, 1913, with signs and symptoms of acute gastric perforation. Prompt operation revealed a large recent perforation on the anterior surface of the stomach, 2 inches from the pylorus. The ulcer edges were closed, and a silk suture was used to cover in the ulcer. An anterior gastro-enterostomy was performed; the stoma was placed below and distal to the perforation. He gave the usual previous history of gastric trouble. He left hospital in good condition.



1. Diamond-shaped area excised with extended vertical incisions above and below. 2, Opening closed along transverse diagonal; 3, fifth perforation; 4, one of four previous ulcers; 5, position of proximal section of bowel, forming site of acute angle after former operation; 6, bowel sutured transversely to stomach for a short distance to prevent recurrence of acute angle.

Six months later, August 1, 1913, he was readmitted to the same service, case number S-1237, with a second perforation. The perforation was 1/8 of an inch in diameter and was in the anterior surface of the jejunum opposite the gastro-enterostomy opening. There was a silk suture found in the perforated ulcer. The ulcer was interned with two linen sutures. Acute dilatation of the stomach occurred on the second day, relieved by posture, gastric lavage, etc. He left hospital free of symptoms.

On October 2, 1915, 2 years and 2 months later, he was readmitted to the same hospital, case number S-2216, service of Dr. A. T. Bazin, with his third perforation which was distal to the scar of the second perforation in the jejunum. The opening was readily closed and a peritoneal silk suture was used.

The fourth perforation occurred in Toronto in August, 1917, when he was successfully operated on by Dr. Kenneth Campbell.

He was admitted to the Montreal General Hospital December 11, 1917, case number 7309, with his fifth perforation. This was preceded for 1 month by gastric symptoms. Immediate operation, by Dr. C. K. P. Henry, revealed a large perforation in the center of a large calloused ulcer, 15 millimeters in diameter, situated at the anterior and mid aspect of the gastro-enterostomy line of union. The ulcer was excised and the incision was carried up into

the stomach and down into the bowel. The opening was then sutured in the reverse way, with three layers of suture, one of chromic catgut and two of linen thread. This produced a larger opening with removal of old scar tissue. The proximal loop of the jejunum was fixed by suture to the stomach wall to lessen kinking at the anastomotic opening. The excised ulcer was reported pathologically to be "chronic ulcer, no malignancy." (S-17-734) Two days later he had acute dilatation of the stomach, promptly relieved by lavage, posture, and pituitrin. He insisted on leaving the hospital on the eighth day after operation and made a quick recovery.

January 24, 1918, a bismuth series gave the following findings: "Meal enters stomach in normal manner. Stomach transversely placed, freely movable, and meal is seen to leave by one opening only, viz., at or near the pylorus. In leaving the stomach it collects in a small freely movable sac which is emptied with difficulty. From here it proceeds obliquely downward and across abdomen in a small stream. Stomach rather large and dilated. No tenderness present. At one and one-half hours about one-quarter of the meal is present; at three hours about one-eighth. At six hours there is slight retention in stomach and head of column is near splenic flexure. *Summary:* Gastro-enterostomy opening is functioning. There is apparently a constriction in the anastomotic loop of small intestine near the stomach. The emptying time of the stomach is very much delayed, the reverse of that which is usual in gastro-enterostomy." (Dr. W. A. Wilkins)

January 30, 1918, he looked well, his weight was 138, average 135; on last admission to the hospital he weighed 127. He had no local tenderness, no flatulency, occasionally had cramp-like pain, bowels moved daily.

In August, 1918, he had no symptoms, and was working hard; in light clothes his weight was 134 pounds.

October 27, 1920, he reported from Ottawa that he was "almost a new man, my weight is 139—pounds, am practically free from symptoms, occasionally have some flatulency, no hæmorrhage."

Summary of perforations:

1. Gastric, February 19, 1913;
2. Jejunal, August 1, 1913;
3. Jejunal, October 2, 1915;
4. Site not stated, August, 1917;
5. Gastric, December 11, 1917.

CANCER OF THE AMPULLA OF VATER

By ROBERT M. LEWIS, M.D., F.A.C.S., Baltimore

THE return of a patient to the clinic for observation 8½ years after a successful radical extirpation of a cancer of the ampulla of Vater by Dr. Howard A. Kelly and Dr. Curtis F. Burnam prompted us to go over the literature on this subject. Altogether there are not many of these cases reported, few in which a radical resection has been done (16), and very few (3) are expressly noted as well over a year after operation.

Of the 16 cases collected by Upcott (1), in which radical operations were performed, one (Koerte's, 2) was reported as living 3 years and 9 months, one 2 years, one 18 months, two 9 months, one 3 months and one 1 month after operation. In three cases an operative recovery only was recorded.

Kausch (3) in reporting a successful operation for a tumor of this region no larger than a bean, remarks that on account of the peculiar site of these growths the diagnosis of a condition calling for operation can be, and is made, earlier than in any other form of internal cancer. We would question whether a carcinoma of the bladder should not be yielded the palm in this respect, while we agree with him that the good operative results and relative benignity of cancers of the ampulla of Vater are due to the fact that they give rise to symptoms very early, and metastasize late.

Most of the primary tumors of the ampulla appear to be adenocarcinoma. According to the textbooks, primary carcinomata causing obstruction at the ampulla may take origin from the common bile duct, duodenum, or either of the pancreatic ducts.

In 1899 Halsted (4) reported the first case of carcinoma of the papilla operated upon by him in February, 1898. He resected a cancer of the ampulla with a portion of the duodenum and pancreas. At a later date a cholecystenterostomy was done. Recurrence and death followed 9 months later.

Hermann Wiedemann (5), as a result of his experimental studies, calls attention to the danger of cholangeitis following implantation of the common duct into the bowel, from the forcing of intestinal contents into the former by peristalsis. He finds that transplanting the sphincter with the duct when possible obviates this danger. This is, however, out of the question where one is resecting a malignant tumor which presumably involves the sphincter itself. Of the six operative deaths only one (Cuneo-Hartmann's case) is noted by Upcott as having died of ascending cholangeitis. Probably, therefore, this danger is not as great as one might imagine. Implantation through an indirect route into the bowel would be ideal, but it is hardly possible on account of the shortness of the common duct.

A positive diagnosis is rarely made in a case of cancer of the ampulla before the abdomen is open.[1] Cordua (6) gives the cardinal symptoms of the condition as first, icterus; second, chronic obstipation; third, distention of the gall-bladder. He admits, of course, that even when these symptoms are evident, certainty as to their cause is not usually possible. Oehler (7) calls attention to the importance of these symptoms, mentioning also the fact that pain is frequently felt in the region of the gall-bladder and that other symptoms usually encountered in disturbances of the biliary passages, such as fever and colic, are rarely found here.

In the cases under consideration quite a number of operations and combinations of operations have been performed either for their palliative effect or for a radical cure. The best and simplest palliative procedure consists in doing a cholecystenterostomy with or without a gastro-enterostomy. One is naturally advised against a simple cholecystostomy. J. F. Erdmann (8) presented a case so treated (cholecystjejunostomy and gastro-enterostomy) with excellent result. During the 4 weeks after operation his patient gained 20 pounds and left the hospital feeling well.

In another instance (Upcott's case), an adenocarcinoma of the ampulla was found with enlarged metastatic glands which could not be removed. Here the primary tumor was excised, the patient made a good operative recovery, and was reported feeling well a month after operation.

The type of radical operation best suited to a particular case depends, of course, on the extent of the disease and the condition of the patient. If the patient is profoundly jaundiced and too ill to stand a resection, it is only the part of wisdom to do a preliminary cholecystjejunostomy—and wait to resect the tumor at a later and safer time. When given a favorable, early case the transduodenal approach and excision is the easiest and should give the best results. This was the method employed in Kelly and Burnam's case here reported.

Halsted and others excised a portion of the duodenum along with a part of the head of the pancreas in removing the malignant growth and then transplanted the common bile and pancreatic ducts into the duodenum.

With either of the above described operations a gastro-enterostomy may be advisable. Halsted did not do this but followed his first operation with a cholecystenterostomy at a later date.

Kausch originated and carried out successfully a difficult and a very radical operation designed for use in those cases where the papillary cancer was extensive. His operation consisted of two stages with an interval of 2 months between. The first step was a Murphy button cholecystenterostomy. This was followed by a resection of a part of the duodenum along with the tumor; division and ligation of the common bile duct; division of the head of the pancreas; gastro-enterostomy; and finally fixation of the open distal end of the duodenum over the divided pancreas. The patient made a good recovery, but to us the operation seems too formidable for use in any but the most desperate kind of a case.

A short summary of the history of Drs. Kelly and Burnam's case of cancer of the ampulla of Vater follows. The patient was

[1] In discussing this point Dr. F. E. Keene tells me that while he was in Vienna some years ago he saw an autopsy done in Kovac's clinic on the body of a patient in whose case a diagnosis of primary cancer of the ampulla of Vater was made before death. Postmortem findings proved the accuracy of the diagnosis.

seen living and perfectly well 8½ years after her operation.

Mrs. J. A., widow, age 45, married, 1 child aged 29. March, 1910.

Family history: 5 sisters all had fibroid tumors; 1 sister had cancer of uterus; mother operated upon for tumor—kind unknown—is now living; father died in 1905 of apoplexy.

Past history: hysteromyomectomy and appendectomy by Dr. H. A. Kelly, 1907; never had typhoid or any other serious illness; no digestive disturbances whatever until 2 years ago.

Complaint: jaundice—indigestion.

Present illness: Two years ago the patient first noticed a sensation as of burning in the epigastrium. This was accompanied by a sense of distress caused by abdominal distention. The pain and gas bore no apparent relation to the time of taking food nor to its quality or quantity. The pain finally became so severe as to require morphia for its relief. At the time of taking the history all foods give rise to burning pain immediately, though this was not so a few months ago. Patient has never vomited. Jaundice has been persistent and increasing for over 2 months. Occasional chills were experienced. There has been no fever. (The temperature has not been taken.)

Physical examination showed deep generalized icterus; heart and lungs, normal; abdomen—liver not palpable below costal margin; gall-bladder cannot be felt. There is some tenderness on deep pressure beneath the right costal margin—no rigidity. No other tender points are discovered. No tumors or organs are palpable. Rectal examination was negative. The urine was loaded with bile. The fæces were constipated and clay colored. Blood coagulation time was not recorded. Other findings negative.

OPERATION BY DR. HOWARD A. KELLY AND DR. CURTIS F. BURNAM

Operation at Church Home and Infirmary, Baltimore, March 28, 1910, with ether anæsthesia. A right rectus incision was made. A distended gall-bladder was noted. There were no stones in the gall-bladder, cystic or common ducts. Stomach and duodenum were normal. The common duct was dilated. On examining its distal end, a hard nodule the size of a bean was discovered through the duodenum at the site of the ampulla. This was evidently causing obstruction to the common duct. It could not be expressed but felt hard and fixed, unlike a stone. The duct was opened and explored but no stone was found.

The duodenum was now mobilized and a longitudinal incision made through its wall directly opposite the mass. The nodule stood out from the duodenal wall, hard and white—evidently a carcinoma. An incision was made about it in the posterior duodenal wall. The nodule and bile-duct were pulled forward into the gut and divided well above the growth. Catgut sutures, interrupted, were then passed through the thin walls of the common duct, fixing it into the duodenum. The opening first made into the latter was closed, and finally the gall-bladder was drained. A cigarette drain was also put down to the closed incision in the common duct.

During the 8 weeks following operation the patient made an uneventful recovery. The jaundice vanished quickly.

July 23, 1919—She has been perfectly well ever since, eats everything that is put before her, and has no jaundice and no digestive disturbance. The abdominal wound is well healed; no hernia. No tenderness on pressure in the region of the gall-bladder.

The microscopic examination of the specimen was made by Dr. Curtis F. Burnam—the findings being a typical adenocarcinoma of the ampulla of Vater.

My thanks are due both to Dr. Kelly and Dr. Burnam for the privilege of reporting their case and for their interest and help in getting together the data.

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THE IMPORTANCE OF A THOROUGH EXPLORATION OF THE INTRA-ABDOMINAL ORGANS IN OPERATIONS FOR EPIGASTRIC HERNIA[1]

By RICHARD LEWISOHN, M.D., F.A.C.S., New York

EPIGASTRIC hernia has been known as a clinical entity for many years. It seems to have been described for the first time by Richter (1) in 1785. The term "epigastric hernia" was used by Leveille (2), in 1812, for protrusions in the linea alba between the processus xyphoideus and the umbilicus.

The French were evidently aware of the frequent occurrence of gastric symptoms in cases of epigastric hernia, because many authors used the term of "gastrocele" instead of "epigastric hernia." They thought that part of the hernial contents consisted of the stomach wall. This same view was expressed by Walter (3) in 1850.

The credit for suggesting operative interference in epigastric hernia with the distinct object of relieving the patients from their gastric symptoms belongs to Kussmaul. Upon Kussmaul's advice, Luecke (4) in 1887 operated upon two cases of epigastric hernia in order to relieve them of their gastric symptoms.

The favorable results obtained in these cases prompted others to assume a very close connection between epigastric hernia and gastric symptoms (hyperacidity, epigastric distress, vomiting, hæmatemesis, etc.). The finding of a small epigastric hernia was considered sufficient by many clinicians to explain the presence of gastric symptoms. In some cases simple hernioplasty undoubtedly was followed by the disappearance of gastro-intestinal symptoms. But in a large percentage of cases the symptoms persisted after the operation.

The question as to how often gastric symptoms are caused by an epigastric hernia and how often they are due to diseases of intra-abdominal organs (stomach, gall-bladder, appendix, etc.) is not a new one. It has been debated by a number of authors for many years. Yet many surgeons, even at the present time, are satisfied to deal with the local condition only, namely, the epigastric hernia. Because of this procedure they cure the epigastric hernia, but frequently fail to relieve the patient of his troublesome symptoms.

We find occasional reference to the coexistence of epigastric hernia and diseases of the stomach as far back as 1890. Témoin (5) published four cases who died from cancer of the stomach, who had been previously operated upon for epigastric hernia. A simple hernioplasty had been performed without any investigation of the stomach, the gastric symptoms being ascribed to the presence of an epigastric hernia.

However, it is only during the last 10 years that attention has been called to the fact that the dictum that simple operation of an epigastric hernia will relieve the patients of their gastric symptoms holds good only in a certain, not too large, percentage of cases.

Capelle (6) reports from Garré's clinic 31 patients operated previously (6 months to 8 years) for epigastric hernia. Four of them had died from cancer of the stomach within 2 years after the original operation. Six had recurrences of their hernia; 12 had no recurrences of the hernia, but had recurrences of their gastric symptoms and only 9 (29 per cent) were perfectly cured. He concludes that the final results following operations for epigastric hernia are far from satisfactory and that every case of epigastric hernia with gastric symptoms ought to have an exploratory laparotomy.

Schloffer (7) comes to the same conclusion. He reports two cases that had been previously operated upon in other hospitals for epigastric hernia. Their symptoms persisted and they were re-operated upon. He found a carcinoma of the stomach in one case and a carcinoma of the splenic flexure in the other. The previous operators had erroneously ascribed the gastric symptoms to the presence of an epigastric hernia.

[1] From the Wimpfheimer Division for Gastro-Enterological Surgery, Service of Dr. A. A. Berg, Mt. Sinai Hospital, and the Surgical Department, Service of Dr. Lewisohn, Beth Israel Hospital

Ertand (8) collected 15 cases from the literature of the co-existence of epigastric hernia with ulcer or cancer of the stomach.

Leriche and Aigrot (9) have reported similar experiences.

Bérard (reported by Colombet, 10) presented a case of penetrating ulcer of the lesser curvature of the stomach which he had previously operated upon for epigastric hernia.

It seems that this subject has been considered rather freely in the French literature. French surgeons have pointed out repeatedly the importance of careful clinical investigations of stomach symptoms without laying too much stress on the sometimes more or less accidental finding of an epigastric hernia.

The frequency of the co-existence of epigastric hernia with intra-abdominal lesions is by no means a rare occurrence, as is made evident by the fact that I had occasion to observe 13 cases in the short period of 4 years.

EPIGASTRIC HERNIA AND ULCER IN THE BODY OF THE STOMACH

Case 1. L. B., age 53; admitted to Mt. Sinai Hospital, October 31, 1916; discharged November 19, 1916. The patient has been suffering from abdominal cramps and constipation for the last 2 years. Pains are often very severe. He has a small, slightly tender epigastric hernia, and there is some deep tenderness on pressure in the right hypochondrium. X-ray examination shows hyperperistalsis, segmentation of stomach, and incomplete filling of the duodenal cap. Clinical diagnosis: epigastric hernia; duodenal ulcer.

Operation, November 1, 1916 (Dr. Berg): The abdomen was opened through an upper transverse incision. The exploration of the stomach revealed an indurated ulcer on the greater curvature about 1½ inches proximal to the pylorus. This was excised. The opening in the stomach, was closed in layer sutures. Adjacent omentum was sewed over the suture line. The abdominal wound was closed.

Uneventful recovery.

November, 1920: Patient is very much relieved since the operation. However, he is still suffering from occasional attacks of hyperacidity.

EPIGASTRIC HERNIA AND ULCER OF THE LESSER CURVATURE OF THE STOMACH

Case 2. N. H., age 47; was admitted to Mt Sinai Hospital (service of Dr. Moschcowitz), on January 15, 1917; discharged March 13, 1917. Patient had been operated upon 10 years previously at another hospital, for epigastric hernia. His epigastric distress was not changed by this operation and his symptoms persisted. His pains are of intermittent character. He is sometimes free from pain for many months. He complains of burning sensation in the epigastrium, occasional vomiting and marked constipation. X-ray findings show a penetrating ulcer at the lesser curvature of the stomach.

Operation, November 19, 1917 (Dr. Moschcowitz): Upper transverse incision. A large saddle-shaped ulcer with a deep crater was found at the lesser curvature. Removal was considered inadvisable on account of dense adhesions with the surrounding organs, especially the splenic vessels. Closure of abdomen in layer suture. The wound opened spontaneously on the fourth day postoperative and required a secondary suture. March 13, 1917: patient discharged. All his gastric symptoms have disappeared.

The patient was re-admitted to the hospital for ventral hernia on March 16, 1918. He did not complain of any gastric symptoms. He was re-operated upon (Dr. Wilensky) on March 19. Exploration of the stomach showed the same condition of the ulcer as on previous exploration. The ulcer was cauterized. The ventral hernia was repaired. The patient made an uneventful recovery, and was discharged from the hospital on April 4, 1918.

Re-examination, June, 1920: Patient states that he feels perfectly well since his last operation. All his gastric symptoms have disappeared.

X-ray report (Dr. Jaches): The stomach shows a very large defect at about the junction of the cardiac and pyloric halves; the defect involves practically the entire gastric wall and allows only a narrow channel between the two parts. The stomach is distorted, but its motility is normal. Both parts of the stomach are empty after 6 hours.

It is obvious from this observation that the penetrating ulcer is still persistent and has grown in size. It is interesting to note that in spite of the size of the ulcer and the secondary hour-glass formation, the patient is at present free from symptoms.

Case 3. M. S., age 36; admitted to Mt. Sinai Hospital, June 6, 1918; discharged June 29, 1918. Patient was operated upon in 1917 at another hospital for double inguinal hernia and epigastric hernia. A double inguinal herniotomy, an appendectomy, and a hernioplasty for the cure of the epigastric hernia were performed. No X-rays were taken previous to the operation. His symptoms recurred 5 months after this operation. He complains of epigastric distress, which has no relation to meals. These epigastric symptoms have persisted with intermissions for the last 3 years; they were attributed to the epigastric hernia and an operation was advised (see above). The X-ray showed a typical penetrating ulcer of the lesser curvature of the stomach.

The operation (Dr. Lewisohn) consisted in an excision of the ulcer and a suture gastro-enterostomy. The patient made an uneventful operative recovery,

He re-entered the hospital on November 14, 1918. A few months after his discharge his symptoms recurred, in fact his pains have increased; there has been considerable loss of weight. Exploratory laparotomy for suspected gastrojejunal ulcer (Dr. Lewisohn): Extensive adhesions between the stomach, omentum, and the anterior abdominal wall were freed. The stoma was patent, perfectly soft, and admitted two fingers. There was no evidence of a new ulcer at the site of excision. Layer suture of abdomen.

Discharged December 1, 1918.

Patient was not relieved permanently. He, therefore, underwent another operation at the hospital where he had been operated upon the first time. The operation consisted of division of adhesions. Seven months later he was operated upon for the fifth time within 2 years by Dr. John F. Erdmann, to whom I am indebted for these notes. The ulcer at the lesser curvature was healed, the pylorus was patent and the stoma was contracted. The gastro-enterostomy was disconnected.

November, 1920: Patient cannot be located.

EPIGASTRIC HERNIA AND CARCINOMA OF STOMACH

Case 4. A. L., age 64; admitted to Mt. Sinai Hospital, May 15, 1919; discharged June 7, 1919. The patient began to have sharp pains in left upper quadrant about 2 months ago; no nausea or vomiting. He has lost 24 pounds in 8 weeks. Physical examination shows a small, somewhat tender, epigastric hernia and an indefinite mass above the umbilicus. X-ray examination shows a hypertonic stomach. The peristalsis is exaggerated. The duodenal bulb could not be visualized properly. The motility of the stomach was delayed, with a slight residue after 6 hours.

Operation (Dr. Lewisohn): Inoperable carcinoma of stomach with metastasis in transverse colon and metastasis in peritoneum. A gland, removed for microscopical examination, showed metastatic adenocarcinoma.

Case 5. H. E., age 60; admitted to Mt. Sinai Hospital, March 10, 1919; discharged March 26, 1919. Patient has been suffering from epigastric pains for the last 3 months, frequent vomiting after meals, and pains shortly after eating. Status: epigastric hernia; indefinite mass in left epigastrium. The X-ray examination showed a large defect of the stomach involving the body and the pyloric parts of the stomach. Diagnosis: epigastric hernia; carcinoma of stomach.

Operation, March 10 (Dr. Lewisohn): Large carcinoma of stomach involving the pylorus and extending almost up to the cardia; involvement of lymph nodes and metastasis in the parietal peritoneum and the liver. Closure of abdominal incision.

EPIGASTRIC HERNIA AND PYLORIC ULCER

Case 6. J. L., age 39; admitted to Beth Israel Hospital, March 28, 1920; discharged April 20, 1920. Patient had been suffering from epigastric pain for over 1 year. These pains had no definite relations to meals. Patient had a moderate-sized tender epigastric hernia. X-ray examination (Dr. Held) showed a pyloric ulcer.

Operation, March 31, 1920 (Dr. Meyer): Epigastric hernia exposed. Incision enlarged from ensiform process to umbilicus. Large indurated ulcer at pylorus. The pylorus was resected. Posterior suture gastro-enterostomy.

November, 1920: Patient feels perfectly well since the operation.

EPIGASTRIC HERNIA AND DUODENAL ULCER

Case 7. A. K., age 37. Patient was operated upon 12 years ago in Russia, for epigastric hernia. He had only temporary relief from his gastric symptoms. He entered Mt. Sinai Hospital in 1915. He presented a recurrent epigastric hernia and the X-ray examination showed a duodenal ulcer.

Operation (Dr. Lewisohn): A crater-like ulcer was found in the first part of the duodenum. A posterior suture gastro-enterostomy was performed. Hernioplasty for epigastric hernia.

He re-entered Mt. Sinai Hospital, December 7, 1916, suffering from a gastrojejunal ulcer. His symptoms (attacks of excruciating pain and nausea) dated back a few months. The X-ray was not conclusive. No abnormalities were noted except for a slight residue.

Operation, December 13, 1916 (Dr. Lewisohn): Pylorus patent, no signs of duodenal ulcer. The stoma showed an indurated ulcer at its anterior wall. Excision of ulcer. Re-suture of defect in anterior wall. The patient made an uneventful recovery.

He re-entered Mt. Sinai Hospital on May 13, 1918, for recurrence of symptoms.

Operation, May 18, 1918 (Dr. Lewisohn): Extensive adhesions between omentum, stomach, jejunum, and anterior wall of abdomen were separated. Large recurrent ulcer at site of stoma. On account of size of ulcer and extensive involvement of surrounding organs radical removal was considered inadvisable. An anterior suture gastro-enterostomy was performed. Uneventful recovery.

Re-examination, January, 1920: Patient feels perfectly well since his last operation.

Case 8. A. K., age 42; admitted to Mt. Sinai Hospital, January 25, 1917; discharged February 9, 1917. Patient had been suffering for the last 4 years from epigastric oppression. He has a fair sized epigastric hernia, tender on pressure.

Operation, January 27, 1917 (Dr. Lewisohn): The epigastric hernia consisted of some preperitoneal fat and did not seem to explain his rather severe symptoms. It was, therefore, decided to explore the stomach and duodenum. A large ulcer without a crater was found at the junction of the first and second part of the duodenum. Posterior suture gastro-enterostomy and pyloric exclusion. Closure of abdominal wall in layer sutures.

November, 1920: Patient cannot be located.

Case 9. M. R., age 51; admitted to Mt. Sinai Hospital, May 6, 1919; discharged June 6, 1919. Patient complains of epigastric pain, loss of appetite, nausea, vomiting, and loss of weight. Onset of pains, 2 years ago. Pains occur 1 hour after eating. Patient has a small, tender, epigastric hernia, otherwise status is negative. The X-ray examination (Dr. Jaches) shows a markedly dilated stomach, the motility is increased. Complete retention after 6 hours. No defect. Diagnosis: almost complete pyloric obstruction, due to cicatrized ulcer.

Operation, May 24 (Dr. Lewisohn): A large, very hard mass was felt in the first part of the duodenum, firmly adherent at its posterior aspects to the pancreas. The mass is probably benign. Removal considered inadvisable. Posterior suture gastro-enterostomy.

November, 1920: Patient's condition is only slightly improved since the operation. He is still complaining of epigastric distress.

Case 10. J. A., age 50; admitted to Mt. Sinai Hospital, March 14, 1919; discharged April 1, 1919. Patient has been suffering from pains in the epigastrium for 25 years. Pains are aggravated by eating. He has a tender epigastric hernia. No intra-abdominal masses are felt. X-ray examination (Dr. Jaches) shows the stomach situated normally. Its tone is good. Peristalsis is active throughout the entire observation. The duodenal bulb is irregular. Slight residue after 6 hours. Diagnosis: duodenal ulcer.

Operation, March 19 (Dr. Berg): A small epigastric hernia was excised; a duodenal ulcer was present in the first portion of the duodenum, with a crater-like depression in its center. Posterior suture gastro-enterostomy and pyloric exclusion.

November, 1920: Patient complains of recurrence of pains during the past few months. He is possibly suffering from a gastrojejunal ulcer.

Case 11. L. R., age 28; admitted to Beth Israel Hospital, February 27, 1920; discharged March 26, 1920. He was operated upon in 1915 for epigastric hernia at another hospital, and in 1916 he was operated upon for recurrent epigastric hernia and pyloric ulcer at the same hospital. In 1917 he was operated upon by Dr. Goodman at Beth Israel Hospital for perforated pyloric ulcer; closure of perforation. He has complained of severe epigastric pains and occasional vomiting for the past 4 months. X-ray examination showed marked tenderness at the stoma without retention. Diagnosis: gastrojejunal ulcer.

Operation, March 3 (Dr. Lewisohn): Many adhesions between omentum and anterior abdominal wall. Liver adherent to parietal peritoneum. Gastrojejunal ulcer at the left margin of the stoma, about ½ inch in diameter. The transverse colon was adherent. It was freed from the ulcer area. The stoma was entered, scar tissue was present at the right corner and anterior wall; it was excised. The stoma was enlarged to admit 2 fingers. The posterior suture line was preserved. The anterior suture line was repaired by two layers. Hernioplasty for recurrent ventral hernia.

November, 1920: Patient is feeling very well since the operation. Diastasis of recti.

EPIGASTRIC HERNIA AND CHOLELITHIASIS

Case 12. M. R., age 46; admitted to Mt. Sinai Hospital, January 16, 1919; discharged February 5, 1919. Patient has complained of intermittent attacks of epigastric pains for the last 15 years. He has noticed an epigastric hernia for 12 years. He has a tender, fair-sized, epigastric hernia. No other points of tenderness.

Operation, January 22, 1919 (Dr. Lewisohn): Median upper abdominal incision. Hernial sac ligated. Stomach and duodenum normal. Gall-bladder full of stones. Cholecystectomy. Closure of abdominal wound, except for drainage. Uneventful recovery.

March, 1920: Patient feels perfectly well. Small ventral hernia at site of drainage tube.

EPIGASTRIC HERNIA AND APPENDICITIS

Case 13. J. L., age 38; admitted to Mt. Sinai Hospital, (service of Dr. Elsberg), June 11, 1920; discharged July 5, 1920. Patient was operated upon in this hospital for epigastric hernia, 18 months ago. His abdominal symptoms were not relieved by the operation. He had a recurrence of his epigastric hernia.

Operation (Dr. Wilensky): Exploration of stomach, duodenum, and gall-bladder negative. Appendix bound down by adhesions. Appendectomy. Hernioplasty.

November, 1920: Patient feels perfectly well since his second operation.

Forty-three cases of epigastric hernia were operated upon in Mt. Sinai Hospital since 1917. It would have been very interesting to follow up these cases and to see how many of these were cured permanently. Cards were sent to all of them. However, such a small percentage of the patients appeared for re-examination that it was impossible to draw definite conclusions. In this city people change their addresses so frequently that it is impossible in many cases to reach them, even after comparatively short intervals.

It seems hardly credible, in view of the operative findings, that serious gastro-intestinal symptoms should be caused by a simple epigastric hernia. Moschcowitz (11) states that "not more than one case in twenty has a true hernial sac" and that "the commonest form of epigastric hernia is sacless, and one in which the peritoneum is not involved in

the least." He believes that the pain is merely a referred pain "and is caused by a dragging upon the falciform ligament of the liver."

There can be no doubt that in a fair percentage of cases the patient is suffering from an epigastric hernia and that the symptoms are caused by the presence of the hernia. In these cases the preperitoneal fat is caught in the hernial ring. This fat protrusion causes a distinct pain on pressure. The pain is local and superficial. Cases of this type are amenable to permanent cure by simple herniorrhaphy. They are not under discussion in this paper.

The cases with which we are dealing are those complaining of a variety of gastric symptoms in a more or less marked degree (anorexia, sour eructations, vomiting, constipation, pains after eating, etc.). The presence of the above symptoms should arouse the suspicion that the epigastric hernia is an accidental finding only, and that the cause of the patient's complaint is probably intra-abdominal.

Three intra-abdominal organs seem to be the most frequent cause for these symptoms; the stomach and duodenum, the gall-bladder, and the appendix. In 11 out of the 13 cases reported above, the lesion was in the stomach or duodenum. The question as to whether a patient, aside from his epigastric hernia, is suffering from an ulcer or carcinoma of the stomach, can be decided readily by the X-ray examination. We know that X-ray examination will, with certainty in over 90 per cent of the cases, settle the question as to whether we are dealing with an ulcer of the stomach or duodenum. Therefore X-ray examination of the gastro-intestinal tract should be part of the routine examination in all cases of epigastric hernia. Yet many surgeons fail to make use of this simple procedure. Thus in many cases the epigastric hernia is operated upon without relieving the patient. Four of our 13 cases were operated upon originally for epigastric hernia without any investigation of the stomach, though they had been suffering from gastric symptoms at the time or prior to the operation.

This brings up another point of great importance. One of the cardinal symptoms of ulcers of the stomach or duodenum is the periodicity of the pains. The pains often subside entirely for many months. If seen in the intermittent period the patient's symptoms may be so slight, that the possibility of the co-existence of epigastric hernia and ulcer of the stomach or duodenum may be overlooked. An X-ray examination will settle this doubtful point in the majority of cases.

The marked intermittence of symptoms is well demonstrated by Case 2. Two previous operations (1917 and 1918) proved the presence of a large penetrating ulcer at the lesser curvature of the stomach. An X-ray picture, taken 6 months ago, shows the large size of the ulcer. Yet this patient, when he presented himself a few months ago for re-examination, was feeling perfectly well and was free from any gastric symptoms, in spite of marked hour-glass formation of his stomach.

The question of the co-existence of appendicitis or cholelithiasis with epigastric hernia is much more difficult to settle than that of ulcer of the stomach or duodenum. The X-ray examination will not help us very much in these cases. We are entirely dependent upon clinical findings. Typical cases of appendicitis or cholelithiasis will be diagnosed easily. However, many cases have such vague symptoms that it will be most difficult to decide, even for the clinician of vast experience, whether the symptoms are due to a diseased gall-bladder or appendix or to an epigastric hernia.

Case 13 told us, on re-examination, that his symptoms persisted unabated after his first operation (hernioplasty). He has been absolutely free from symptoms, since his appendix was removed. I went into the history of his case very carefully, and feel sure that the second hernioplasty for recurrent epigastric hernia would not have cured this patient, if his diseased appendix had not been removed at the same time.

The surgeon used to pride himself upon making the abdominal incision for removal of the appendix as small as possible. However, experience has shown that such a procedure is not in the interest of the patient,

except in very typical cases. Re-operations for diseases of the gall-bladder, stomach, female pelvic organs, etc., which had not been amenable to investigation on account of the small incision, became very frequent. The experienced surgeon, therefore, prefers to make the abdominal incision long enough to facilitate thorough examination of the intra-abdominal organs.

The time has thus passed for the small appendicular incision. In the same way the time will pass for the small incision for epigastric hernia. Every patient who has associated with his epigastric hernia vague symptoms which might possibly be ascribed to an affection of the intra-abdominal organs, ought to have the benefit of a thorough exploration. If this procedure is carried out consistently, statistics will demonstrate, that epigastric hernia *per se* is responsible for intra-abdominal symptoms in a comparatively small percentage of cases.

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A CLINICAL STUDY OF THE PLACENTA

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IS there any relation between some of the abnormalities of the placenta and the clinical events of the patient's pregnancy? To answer this question I have tried to make observations from this point of view and have come to some conclusions which I wish to present in this paper.

First, I wish to consider briefly a normal placenta. When this organ is found after delivery in a condition above reproach, it consists of a circular mass of tissue with the cord attached to its center and the membranes attached to the edge. The maternal side appears as a homogenous red surface and the circumference or edge is well defined and devoid of indentations. The fœtal side of the placenta is covered by amnion and chorion and beneath these translucent membranes may be seen the blood vessels which carry the fœtal blood from the cord to the regions of the villous membrane and return.

Normally the placenta increases in size concentrically so that, in a full term placenta, the cord comes away from the center of the symmetrical circle formed by the edge of the placenta. The normal position of the placenta is near the opening of the fallopian tube through which the ovum descends to the uterine cavity.

It may be said here that very few placentas will be found which conform to this description. Nevertheless, this fact coincides with the fact that the close study of the clinical events of pregnancy will show that there are very few uncomplicated pregnancies.

There are two forms of macroscopic abnormality in the placenta which I wish to consider, the so-called "infarct," and the asymmetrical placenta. The infarct has long been the subject of controversy not only as to its etiology but also as to its pathology and to its effects on both mother and baby. It would make this paper too long to consider all that has been written on this subject, and I shall take up only those observations which tend to show the points I wish to bring out.

Macroscopically, the infarct is a whitened, hardened area of placental tissue which is found most commonly on the edge of the placenta but may show in the central portions either on the maternal or fœtal sides of the placenta. Infarcts are ordinarily irregular in outline. Frequently this whitened area will extend along the edge of the placenta for a distance of several centimeters, the width of this strip varying from 1 to 2 centimeters.

The centrally located infarcts vary from the size of a millet seed to that of a pigeon's egg. There is the greatest variety in number. Many times the whole surface of the placenta is involved.

Microscopically, the lesion is described as follows: Dieulafoy, (1) "The lesion is characterized by the appearance of hæmorrhages which are converted into white infarcts. The primary lesion is hæmorrhagic in nature; the white infarct is secondary. Furthermore, it is always intraplacental and most often intracotyledenous. . . . The recent infarct contains fluid blood or, having a gelatinous consistency, is almost of a black color. . . . When the infarct is older it becomes pale, the coloring matter of the blood disappears gradually . . . . and finally reaches the tint of the white infarct. If the infarct is incised, it appears formed of fibrin more or less dense and homogenous in appearance, and sometimes disposed in a series of concentric layers. In the center we often find a small collection of more or less colored fluid, forming the residue of the blood serum. . . . The hæmorrhage may give rise to retroplacental hæmorrhage which may prove fatal to the mother. It is needless to add that in the same placenta we may find recent and old foci, and thus very easily follow the different degrees in the evolution of the placental hæmatoma described above."

It is my belief that there are also lesions in the placenta which show that some of these infarcts become completely absorbed.

DeLee (2) describes the microscopic appearance of an infarct as "circumscribed areas of placental tissue which have undergone coagulation necrosis. In the advanced stages the whole mass is changed into fibrin with only traces of the previously existing villi. Sometimes there are evidences of obliterating endarteritis and peri-arteritis."

From the above descriptions, it is plain that the so-called infarct is a pathological element in the placenta. The fact that these areas occur most consistently when syphilis, chronic nephritis, and toxæmia of pregnancy are associated, also tends to show that they are pathological elements.

LaVake (3) in an article on the "Infection Theory of Pre-Eclamptic Toxæmia and Eclampsia" takes up the question of the etiology of the infarct. He quotes the work of Young (4), of Edinboro, who by examinations and animal experiments showed the infarct to be a thrombotic process beginning in the maternal blood vessels which results in the death of the part supplied, with subsequent autolysis. LaVake then raises the question as to what is the cause of the primary thrombosis. It is generally admitted that thrombosis in other parts of the body has an infectious basis. In support of this view, he quotes the work of MacLean (5) on the cause of thrombosis in abdominal surgery, whose conclusion is that the "main contributory causes are, probably, a low grade infection, not of a sufficient virulence to be noticed clinically, and the slowing of the blood stream."

LaVake then goes on to show that in every case of eclampsia a focus of sepsis, either acute or chronic, can be demonstrated. This statement exactly coincides with my own experience which has been set forth in two papers (6 and 7) already published.

There is, therefore, good ground for believing that the co-existence of chronic sepsis with pre-eclamptic toxæmia and eclampsia is more than a mere coincidence and that these foci are the source of the infection which causes the local thrombosis in maternal uterine blood vessels supplying the placenta with resulting infarcts.

I wish to refer again to a case reported by Cornell and Earle (8), the great importance of which in this connection will be self-evident. In this case a hysterectomy was done on a uterus 2 months pregnant immediately following a bleeding spell or threatened miscarriage. A careful pathological examination of this specimen with the placenta still in place in the uterus is reported as follows: "The only abnormal feature of this placenta is the abundance of necrotic areas in the decidua adjoining the intervillous space. The margin of these areas is densely infiltrated with leucocytes. . . . They show profound necrosis centrally, there may be some hæmorrhage, and there is always a margin densely infiltrated with polymorphonuclear leucocytes. . . . One small area . . . . showed . . . . a villous with œdematous stroma. These observations point to a beginning abscess formation with spreading of infection to the ovum. Slides stained with Gram's stain afford some inconclusive evidence of the presence of gram positive cocci but the histological appearance of the necrotic areas points clearly to their infectious origin."

This is in all probability a description of the earliest form of placental infarcts. To complete the picture, the history in this case states that the patient had been suffering from a "cold" for 3 weeks preceding the uterine bleeding.

Besides this case, there is much clinical evidence of the relation between acute infection in the mouth and respiratory tract and miscarriage and threatened miscarriage.

It has been my contention that if miscarriage, threatened miscarriage, and premature births can be attributed to acute infection, it is a logical sequence that the same results may come from chronic or low grade sepsis wherever situated in the body. It is a logical conclusion, therefore, assuming that the infarct is the result of hæmatogenous infection of the placental site, that in certain cases the placenta will present a record of these acute infections or the moments of activity on the part of foci of chronic sepsis.

I wish to report such a case and from it draw some further conclusions which I believe to be of great significance.

Patient, a primipara, age 28, family history negative, gave no history of scarlet fever or other serious illness but stated that she had not felt well for years. Her tonsils and adenoids had been removed at 12 years of age and she had not been subject to sore throats since. She had been subject, however, to severe occipital headaches, some neuralgia of the face and rheumatism of the shoulders.

Her menstruation had been regular, last period March 7, 1920. On May 9, 1920, I was called on account of uterine bleeding. There had been staining on two previous occasions, on April 9, and May 1. She complained of much nausea without vomiting and a great deal of soreness and pain in the lower abdomen for the past few days. She experienced pain in the lower abdomen when she took a long breath.

Examination seemed imperative in spite of the presence of bleeding, and I found a uterus enlarged to a two months' pregnancy. On the left side was a tender mass the size of a small hen's egg. There was tenderness in the right lower quadrant also. In consultation with Dr. Rose, an ether examination was obtained and the findings seemed to warrant opening the abdomen although the mass under ether felt less like an extra-uterine pregnancy than at the first examination.

The mass proved to be a cystic ovary but the appendix showed definite inflammation with an enlarged tip. The appendix was removed. Recovery was uneventful and the nausea disappeared for a month.

On June 7, she reported more nausea, severe headaches and aches all over. Believing that her past and present history suggested a focus of sepsis, X-rays were taken of her teeth. In the upper left lateral region a large abscess was found with considerable necrosis of the bone. Following the removal of this infected tooth and curettement of the bone, the patient developed a cervical discharge which required the wearing of a napkin. Under treatment this discharge cleared up in about 2 months.

It is interesting to note that the occipital head aches ceased one week after the extraction and did not return throughout her pregnancy.

The pregnancy continued normal without rise of blood pressure or untoward symptoms until just as labor began, the patient called to state that she had just passed about an ounce of pure bright blood from her vagina. She had a normal delivery on December 8, 1920, of a 6 pound, 12 ounce baby. The baby showed a right congenital valgus.

The placenta in this case was shaped as follows: The cord was attached at a point about one inch from the margin of the placenta. Along the edge nearest to the cord attachment were two white infarcts. The distance from the base of the cord to the edge of the placenta opposite to the infarcts was about 7 inches. The general shape of the placenta was oval. The membranes were very complete and showed the point of rupture to be at the edge of the placenta at a point directly opposite to the two infarcts. There were no other infarcts visible in the placenta.

Now let me apply the clinical events of this patient's pregnancy to the findings in the placenta. At about 2 months we know that the patient had an active infection in her system as represented by the inflamed appendix. Corresponding to this time in the growth of the placenta we also find two infarcts so situated in the placenta that they must have occurred at the edge of the placenta when the placenta was about 2 months old. The presence of acute infection in the system at this time is therefore established. The damage done to the placenta at that time was sufficient to prevent the continued growth of the placenta in that direction. In order to compensate for the demands of the growing fœtus, the placenta must necessarily enlarge in other directions. In this case we have evidence that the injury to the placenta was on its upper edge and that the compensating growth of the placenta was downward toward the lower uterine segment. This evidence is incontrovertible because the opening in the membranes was at the edge of the placenta farthest away from the cord, showing that the placenta at this point was near the cervix. The clinical history again corroborates this statement. You will remember that the labor was begun with actual bleeding, small in amount in this case but enough to be attributed to the presence of a low attached placenta.

It has long been the belief that the asymmetrical placenta is a matter of no significance. DeLee in his textbook so states the situation. This case seems to contradict this view when interpreted on the basis of the infectious origin of infarcts. There is great importance in this view of the case for it will explain other clinical phenomena.

The frequency of antepartum hæmorrhage associated with toxæmia of pregnancy has long been a well established fact. Many such coincidences may be attributed to situations similar to the one shown. Even some of the cases of marginal placenta prævia may be brought about in the same manner. Observa-

tions with this view in mind ought soon to establish its truth.

It is impossible to leave the discussion of this case without raising one other point. Was the appendix the primary focus of infection which sent bacteria into the blood stream of the mother to cause the infarcts, or was the infection of the appendix and the placental site simultaneous resulting from the chronic abscess in the teeth?

Personally I believe the latter hypothesis to be the correct one and it agrees with Rosenow's theory (9) that appendicitis is frequently a hæmatogenous infection. The infarcts were not caused in all probability by the extraction of the teeth because we have the evidence of the threatened miscarriage coincident with the acute inflammation of the appendix. In all probability this bleeding was the outward manifestation of the damage to the placenta which later appeared as the white infarct.

The writer does not wish to imply that the interpretation of this case will explain all low attached placentas, or all antepartum hæmorrhages. It must be remembered that in order to reproduce such a case, the infection of the placental site must occur at its upper edge and be sufficient to stop its growth on that edge. Likewise, the primary attachment of the ovum to the uterine mucosa must be at a point low enough so that the downward growth of the placenta will reach the lower uterine segment.

The most important feature of this case is that it clinically supports the contention that the placental infarct is of infectious origin and may come from a focus of chronic sepsis.

It is a well known fact that the infarcted placenta is far more common than the one without infarcts. If these infarcts are of infectious origin, they present indisputable evidence of the presence of bacteria in the blood stream of the individual far in excess of any other evidence yet submitted. The importance of this fact is as great in general medicine and surgery as it is in obstetrics.

The following is a report of a similar case which has occurred since writing this paper:

A multipara, age 27, had an appendectomy in 1913. Her tonsils and adenoids were said to have been removed in the same year. Her obstetrical history is as follows: First pregnancy was a miscarriage. Second pregnancy was an instrumental delivery at home. Baby weighed only 5½ pounds. Headache and vomiting were present throughout this pregnancy. (The small weight of the baby and the symptoms probably mean a toxic pregnancy.)

The third pregnancy occurred in 1916 and she had headache and vomiting throughout. One week before delivery she came to Memorial Hospital because of facial paralysis on right side associated with soreness and swelling behind right ear. Blood pressure was 150-78; white count 25,000. Labor was induced by Voorhees bag and forceps delivery on account of pre-eclamptic condition. Baby weighed 8 pounds 10 ounces. Paralysis disappeared before discharge from hospital. Fourth pregnancy. First seen in out-patient department, July 6, 1920. Last period March 28, 1920. Complained of vomiting, headaches and blurred vision. Blood pressure was 104-74. During the last of June, she had *an abscess opened in right ear.* July 4, felt a great deal of pressure in pelvis and on July 5, passed a small amount of bright red blood.

Examination showed that the ear had stopped discharging. There was a large amount of tonsillar tissue still present. There was also one devitalized molar on the lower right. Headache and vomiting persisted until the tonsils were removed on August 20. Following the removal, the patient stated that she felt much better and throughout the rest of her pregnancy, she had only occasional headache with vomiting. Highest blood pressure recorded up to delivery 130-90. She had a marked leucorrhea requiring a napkin which began soon after the bleeding in July. This leucorrhœa had not existed previously.

Patient had a normal delivery. The placenta showed the following characteristics: The cord attachment was near the edge of the placenta and along this edge was marked white infarction. The placenta was oval in shape and differed from the other placenta in that the long diameter was parallel to the infarcted edge. The opening of the membranes was about 3 inches from the edge of the placenta and opposite to the infarcted side of the placenta.

Look at this patient's whole obstetrical history as a clinical entity. In each pregnancy we find pathology. This pathology is all of a similar nature when viewed from the standpoint of chronic sepsis. We start in 1913 with what was in all probability a tonsil clipping operation, an operation which is believed today to increase the pathology of the tonsil so treated. Here, therefore, is a focus of chronic sepsis at the start. Then follows a miscarriage; then two toxic preg-

nancies, the second of which is accompanied by infection in the region of the right ear. Four years later another pregnancy is complicated by an active otitis media of the same ear which is clinically followed by a threatened miscarriage. It is common knowledge that repeated ear infection is frequently due to chronic infection in the tonsils. Toxæmia does not develop in this last pregnancy after removal of the tonsils. The placenta, however, records the damage done at the end of the second month of pregnancy. Evidence of the time of this damage is shown by the bleeding on July 5, which was immediately preceded by the acute otitis media.

Attention is also called to the appendectomies which appear in both these cases.

CONCLUSIONS

1. Placental infarcts are the results of hæmatogenous infection of the uterine blood vessels, resulting in localized thrombosis.

2. As such, they are a clinical record of the presence of bacteria in the blood stream of the pregnant woman.

3. The injury done to the placental site, when it occurs in the early months of pregnancy, may affect the shape of the placenta and thus account for certain of the complications of pregnancy.

4. The obstetrical history of the second case reported represents a clinical entity with chronic sepsis in the tonsils as the continuous etiological factor.

5. Placental infarcts give more positive evidence and of greater value than blood culture methods of the presence of bacteria in the blood stream.

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DEPARTMENT OF TECHNIQUE

THE TREATMENT OF PROLAPSE OF THE URETHRA

With Report of a Case

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THE surgical treatment of prolapse of the urethra is unsatisfactory: first, because an operation is done *on the urethra*, which as a rule is not the offending member, being only made so by some other condition such as cystocele, procidentia, *urethral* caruncle, etc.; second, because the operation is a delicate one and requires great skill to perform; third, because of the danger of cicatricial contraction and resultant stricture of the urethra.

Knowing the value of fulguration in reducing œdema of the bladder and ureter, I used the monopolar current on the case I wish to report, with most gratifying results.

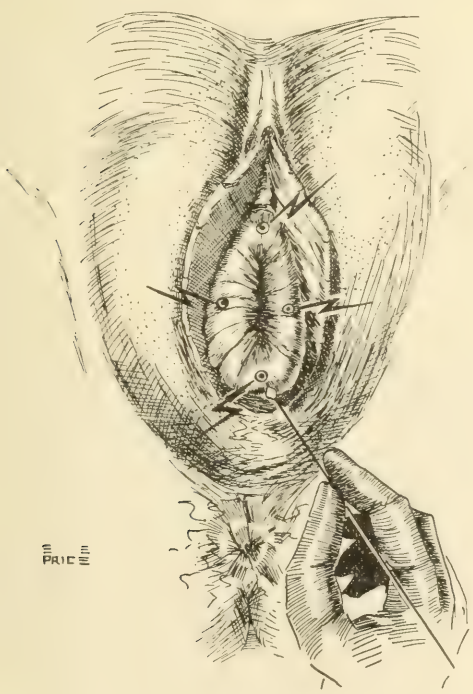

Fig. 1. Application of fulguration for prolapse of the urethra.

The patient is a large fleshy woman, widow, age 63; mother of one son, age 39; family history negative. She had an operation for hæmorrhoids in 1890, one for fissure of the rectum in 1904, one for cystocele and laceration of cervix in 1908, one for cholecystitis (gall-bladder drained) and recurrent cystocele in 1915.

The cystocele recurred one year later, but caused no special discomfort until the past year, when she had some backache and a sense of lack of support of the pelvic floor. December 1, 1920, she was in an elevator that dropped about 12 feet. This caused a severe pain in the urethra, and a few hours later there was a protrusion at the external meatus. This gradually increased in size and was accompanied by pain, frequency, tenesmus, and the passage of blood-stained urine. Four days later, she came to Memphis. Upon examination I found a complete prolapse of the urethra as shown in the accompanying drawing. She was in constant pain; there was a serosanguinous discharge from the prolapsed mucous membrane, and urination was frequent and excruciatingly painful. A tight band seemed to constrict the prolapsed portion of the urethra at the external meatus. A No. 14 F. soft rubber catheter passed, with some difficulty and much pain, into the bladder, but gentle palpation of the prolapsed membrane was unbearable.

The fulguration electrode was placed at the four points of the compass as shown in the drawing, and the monopolar current applied for a few seconds at each point.

Compresses, saturated with lead and opium lotion, were ordered and continued throughout the treatment.

She was markedly relieved by the one fulguration, and slept better that night than at any time since the prolapse occurred. The next day she was greatly relieved and urination was devoid of pain except for slight burning.

After 7 days her condition was so much improved, fulguration was repeated, and in another week all trace of the prolapsed membrane had disappeared and the urethra felt quite normal again.

I can find no mention of the use of fulguration in the treatment of prolapse of the urethra in the literature to which I have had access, and as the only satisfactory treatment, heretofore, has been resection of the prolapsed mucous membrane, the simplicity and ease of application of the high frequency current and the successful result in this case make it worthy of report.

A THREAD-RETAINING NEEDLE

By DUFF S. ALLEN, M.D., St. Louis
From the Department of Surgery, Washington University

A SIMPLE needle that will not come unthreaded while being used is based upon the idea of two tapering slots which grasp a section of the suture and hold it taut by reason of the narrowest portion of the one being directed toward the narrowest portion of the other. The remainder of the needle is fashioned so as to prevent this grasp from being disturbed by manipulation and to allow for ease in threading the suture into the two slots. The drawings show this in detail:

The split, *x*, in the end of the needle is at an angle of 90° to slot *b*. This is so arranged to form the guards which prevent the suture from slipping out of slot *b*, and so that when the suture is drawn into slot *b* and has spread it the split *x* still remains closed. The edges of both slots are rounded along their entire lengths—on both top and bottom sides of the needle—and this is continued as a groove across that solid portion of the needle which separates the two slots. This prevents cutting of the suture and also reduces the bulk of the needle. The needle may be either straight or curved.

To thread the needle, pass the end of the suture through eye *e* and pull the suture down firmly into slot *a*, then snap the longer end of the suture into slot *b* and, particularly with silk or linen, follow with the shorter end (Fig. 2).

A serviceable needle that will not come unthreaded must embody three main principles; first, it must pass through the tissues without great difficulty; second, it must be easy to thread; and, third, it must hold the suture under all conditions. This needle, I believe, will fulfill all three of these requirements.

In the first instance the largest portion of the needle is the eye *e* through which the end of the suture is passed. This need not, however, be larger than the eye of the ordinary needle. From this eye backward the size of the needle is governed by the amount of metal necessary to give the proper strength to grasp the suture. This has been found to be of such size that with the sutures in place no excessive enlargement results, for enough metal can be sacrificed to make the size of the needle here consistent with the size of the needle elsewhere.

In the second instance we find the needle almost as easily threaded as the ordinary needle. The only additional manipulation necessary is the snapping of one or both ends of the suture into the end of the needle. This requires only a second. It is so easily and simply done that no one will find it difficult.

In the third instance the needle is so constructed that the suture becomes more firmly engaged as it is being used. By pulling the needle through the tissues the suture is pushed backward and

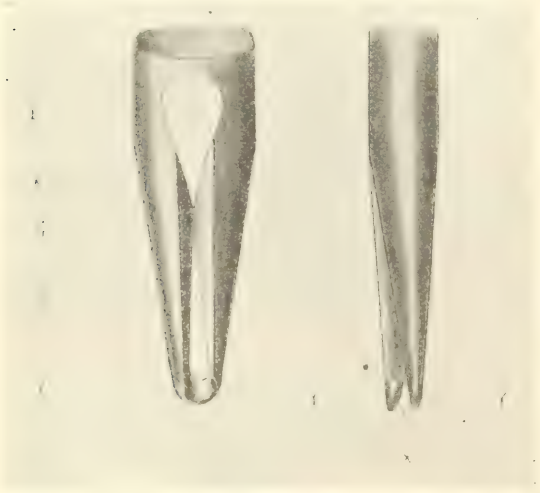

Fig. 1. *E*, Eye of needle; *a* and *b*, slots of needle; *x*, split in end of needle; *y*, guard; *g*, groove.

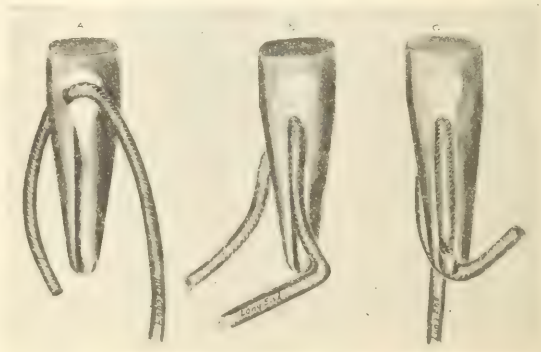

Fig. 2. Shows method of threading needle.

downward into the slots which hold it. It is seen by microscopic examination of the used catgut suture that on either side of those portions of the suture which are compressed in the needle there is an enlargement in the suture which prevents its slipping through the slots. Thus it is found that even after the suture becomes moist with blood or other fluids, it becomes all the more firmly anchored in the needle. The slots in the needle are narrowed down to enable the same eye to grasp even the finest as well as the coarser sutures. The needle is designed so that the suture will not become disengaged from it by pulling upon it from any angle.

In addition, this needle sews more rapidly than the ordinary needle. With the single thread it is not necessary to catch the suture when pulling it through the tissue. With the same forceps which pulls the needle through the tissues to complete the stitch, the suture can be drawn through by traction on the needle without disengaging the forceps from it. Thus the needle is pulled through the tissues and the suture drawn tense with one movement of one hand.

SURGICAL POSTOPERATIVE TREATMENT

By R. V. B. SHIER, M.D., Toronto
From the Surgical Clinic of Dr. F. N. G. Starr

THE material for this paper has been derived from observations of surgical patients where careful attention to detail is carried out in this phase of our surgical therapy. It has been my privilege to study, in association with Dr. F. N. G. Starr and Dr. Roscoe R. Graham, twelve hundred postoperative cases during the last 12 months. Certain definite lines of therapy have been adopted, varied to the needs of the particular case, but it is in reference to abdominal surgical cases that these remarks are particularly directed.

To be successful, hearty co-operation between physician and surgeon is essential, and personality, as well as sound judgment, counts for much. To us the doctrine of "masterly inactivity" is dangerous teaching—but fussiness is never desirable. Mild cases, it is true, require little attention, apart from what are usually considered unimportant details. However, every case of any magnitude requires close watching if good results are to be obtained. One will be repaid by a decrease in the mortality rate, as well as in the period of morbidity.

Purgation the night before operation is harmful. The hospital and the operation are events in the patient's lifetime. Rest and quiet to body and mind are the indications. Therefore do not let a dose of castor oil the night before deprive the patient of these essentials. A very satisfactory plan is to give a mild laxative two days before the date of operation, and on the evening before operation a simple enema, which is repeated the following morning. If the patient is nervous, and it is desirable to secure a good night's sleep, sodium bromide 20 grains and chloral hydrate 10 grains, or 1 grain of codeia may be given by mouth. If the patient is weak or exsanguinated, a preliminary transfusion of whole blood is of decided value. Failing this, an intravenous injection of 1000 cubic centimeters of 10 per cent glucose in normal saline is of decided value. The latter, being a monosaccharide, can be directly utilized as food, and is an admirable substitute for whole blood in such instances. Gastro-enterostomy cases receive gastric lavage the night before and 1 hour previous to operation. We do not give morphia and atropine as a routine before the anæsthetic, on account of the risk of postoperative nausea. Another drawback is that pupil reflexes are lost as a guide to the anæsthetist.

During the operation, if shock is likely to be a prominent factor, we resort to the old time, interstitial, or normal saline at the commencement of the procedure. If there has been considerable blood loss, 6 per cent gum acacia is given intravenously to the amount of 1000 cubic centimeters. To avoid reaction from this, the gum must be dissolved in freshly distilled water, and, of course, sterilized.

For the first 3 or 4 days after an operation of any magnitude, there are as a rule three outstanding symptoms: (1) pain; (2) distention or meteorism; and (3) nausea and vomiting. If these are eliminated, there are very few other postoperative troubles. While routine orders are not favored, we have an order which applies

to all severe or moderately severe abdominal cases. The results which have been obtained since using this routine are its main justification. The order is as follows: morphia sulphate, ¼ grain and atropine sulphate 1–150 grain, hypodermically as necessary for pain or restlessness; strychnine sulphate, 1–30 grain, hypodermically every 4 hours for the first 48 hours; Murphy drip with glucose 10 per cent, sodium bicarbonate, 5 per cent, with concentrated tincture digitalis (B. & W.) 2 drachms to the first 10 ounces.

There can be but little doubt that morphine and atropine, in liberal doses, given during the first 24 hours, is the one combination par excellence for pain and restlessness. Mental and physical rest are so important, that remedies less reliable are a waste of time. Codein, while soothing to the nervous system, fails to relieve severe pain. Aspirin, so commonly used in conjunction with codein, tends to increase the nausea. The argument that morphia encourages postoperative distention seems either to have been exaggerated, or our further postoperative measures combat its influence. A great deal of the trouble that opponents of morphine have experienced has been due to too small dosage. When morphia is used in sufficient dosage to relax spasm of the abdominal muscles and allow of painless contraction, the patient experiences little difficulty in expelling gas, and has no pain while so doing. We give strychnine mainly for its tonic action on the unstriated muscle fiber of the intestine—an important point in the prophylaxis of distention.

The second postoperative difficulty—meteorism or distention, is much easier to prevent than it is to cure. It is toward the prevention of this condition that we find digitalis so valuable. One has only to compare the patients operated upon before its use, with those of the past year, to appreciate the improvement. Just how digitalis prevents distention is open to discussion. Aside from its undoubted action on the heart and circulation, we feel that it has a direct action on the intestinal musculature, as well as through the vagus. After its use we have no difficulty in getting bowel action, and whereas formerly we prescribed pituitrin and eserine frequently, we now only occasionally use them.

To illustrate this striking local action of digitalis, we will quote the following case:

A girl, age 25, was operated upon for stone in the common bile-duct, it being necessary to open the duodenum. The postoperative course was stormy. Digitalis was not given in this case immediately after operation, and distention and vomiting were severe. At the end of 4 or 5 days the bowels having failed to react to purgatives and enemata of various kinds, we gave, per rectum, 2 drachms of concentrated tincture of digitalis in 3 or 4 ounces of water. Two hours later the patient had a copious bowel movement, and was greatly relieved.

This is the only case where we have used digitalis at this late period, for since adopting it as a constituent of the Murphy drip, and giving it immediately on the patient's return to bed, we have been able to avoid difficulties such as the above. At this juncture we wish to point out that to derive the most benefit, it is essential that it be started within the first hour of the patient's return to bed—that the Murphy drip be not faster than 40 or 60 drops to the minute, and that only 8 or 10 ounces of solution be given, to insure absorption. After the 8 or 10 ounces are given, the drip is discontinued for 3 to 4 hours, and repeated with glucose and soda alone. Another important point with regard to the use of digitalis is its value in preventing the tachycardia that occasionally follows cholecystectomy. Most surgeons have noted this alarming and sometimes fatal complication. Since using digitalis, there has not been a single instance of this.

In some cases, even with digitalis, one gets a moderate degree of meteorism. If such occurs, we use pituitary extract, 1 cubic centimeter, immediately followed by a 1.2.3. enema containing turpentine, 1 drachm. It is important to give the two at the same time, or the pituitrin a few moments after the enema. The practice of preceding the enema with the pituitrin by a period of 15 minutes is faulty, and the results not so good. Sometimes pituitrin fails to work, in which event eserine 1–50 grain every 2 hours for 3 doses may be used. It is strange, but nevertheless a fact, that eserine acts best in those cases where pituitrin fails.

We now come to another troublesome postoperative difficulty—nausea, often associated with vomiting. There are 5 types which require differential diagnoses in order to have successful results: first, anæsthetic; second, acute dilatation of the stomach; third, obstructive; fourth, toxic; fifth, neurotic. We will discuss the differential diagnoses and treatment of each variety in turn.

1. *Anaesthetic.* This follows, if not immediately, in a few hours after the anæsthetic. It is characterized by persistent nausea and the vomiting of any water taken, together with small quantities of bile. Even without treatment, it should be over in 48 hours, except in exceptional cases. If it is prolonged after the third day, one should

be suspicious of the fifth, or neurotic variety. The treatment depends, in this as well as in any variety of vomiting, on whether the stomach completely empties itself or not. If there is reason to suspect that the stomach does not empty at each emesis, the stomach tube and a copious gastric lavage with weak sodium bicarbonate solution are indicated. If the stomach empties, or is emptied by the tube, relief may be given by administering the following: 1 drachm peroxide, 6 drachms normal salt solution.

If the first dose is vomited, repeat in a few moments. If this fails, a good plan is to add cocaine: 1 drachm peroxide, 6 drachms normal saline, ¼ grain cocaine.

This may be repeated in half an hour if vomited. Sometimes adrenalin and cocaine act well: adrenalin, 1:1000, minims 25; cocaine, ¼ grain; normal saline, 2 ounces.

To be repeated if the first dose is vomited.

During the second 24 hours, a number are benefited by buttermilk or coffee, and some by acid hydrochloric (dil) and bismuth. A remedy recently used is benzyl, benzoate of sodium. The dose is 15 minims, mixed with five times the quantity of 90 per cent alcohol. This is again given in 2 or 3 drachms of water, the mouth being immediately rinsed out. We have used this last remedy only a few times, and have found it of marked value. We allow our patients water in abundance, and find that it does not increase the vomiting, but adds greatly to the comfort of the patient.

2. *Acute gastric dilatation.* This occurs after cholecystectomy more frequently than after any other operative procedure. It occurs also fairly often after removal of large ovarian cysts. It is characterized by the vomiting of olive green, foul-smelling material. Instead of vomiting naturally, this offensive material spills out over the patient's chin. It occurs about the third or fourth day—sometimes earlier. It is easily mistaken for intestinal obstruction, but as a rule occurs earlier in convalescence, and is not associated with pain. In cases of acute dilatation, on passing the tube after a vomiting spell, one obtains a couple of quarts of material, whereas in obstruction the stomach empties itself. As to treatment—there are only two things to do: repeated gastric lavage, and the right lateral position for the patient. These patients must be kept lying on the right side, and the stomach must be washed at least every 2 hours if a fatal result is to be avoided. It is in this type of vomiting that we are particularly partial to the use of the duodenal tube. It may be fastened in by adhesive on the cheek. The nurse, in the absence of the house-surgeon, pumps the stomach at the 2-hour period. In the event of a duodenal tube not being available, an ordinary stomach tube passed each time is quite efficient, and has the advantage of being more easily passed than the duodenal tube. In a delirious patient it is almost impossible to pass the latter.

3. *Obstructive vomiting.* This is as a rule early in convalescence from paralytic ileus, or later from bands or adhesions. If due to ileus, repeated lavage is necessary, but if due to organic causes, operation must be considered. It is interesting to note, in studying our cases, that by avoiding meteorism, as pointed out in this paper, the cases diagnosed as paralytic ileus are falling into small numbers.

4. *Toxic.* This occurs after prostatectomies, and is an evidence of uræmia. The element of acidosis in some of these cases must not be forgotten. There is in the uræmic type, increased non-protein nitrogen in the blood, and in those due to acidosis, an acetonuria. The indications are to flush the channels of elimination—by interstitial saline: epsom salts by mouth, if they can be retained at all, and glucose and soda intravenously, or per rectum, preferably the former. Benzyl works best as a remedy by mouth.

5. *Neurotic vomiting.* This occurs in two classes of individual—those who have had previous anæsthetics, and those who are overwise about anæsthetic vomiting, as doctors and nurses. Any vomiting of the anæsthetic type which persists after the third day is usually neurotic, and should be so treated. The remedy is sodium bromide 100 grains per rectum, or sodium bromide 80 grains, and chloral hydrate, 40 grains, per rectum. Either may be repeated in 4 or 5 hours.

We usually give a dose of castor oil at the end of 48 hours. Daily bowel action thereafter is desirable, either by pill aloin, belladonna, strychnine, and cascara, or liquid paraffin. Food is liquid or semisolid for the first 48 hours; after that the diet may be increased according to the individual case. Gastro-enterostomies are fed as any other case, usually put on malted milk; junket or custard on the second day. We rarely use morphine as a sedative after the first 36 hours. Other sedatives or hypnotics are used when indicated.

The conclusion one arrives at is that postoperative therapy is important; that personality of nurse and doctor counts for much, and that morphia, digitalis, and a stomach tube are life-saving.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

Regular Meeting Held November 5, 1920, Dr. William Fuller, Presiding

Dr. Hollis E. Potter read a paper (by invitation) entitled "The Buckey Diaphragm Principle Applied to the Radiography of Deep Osseous Structures."

Dr. Emil Beck read a paper entitled "Immunity Versus Disease."

TREATMENT OF FRACTURES OF FEMORAL DIAPHYSIS IN CHILDREN UNDER TWELVE YEARS

Dr. Kellogg Speed read a paper entitled "Treatment of Fractures of the Femur in Children." (See p. 527.)

DISCUSSION

Dr. Frederick G. Dyas: I have been associated with Dr. Speed in this particular work, and I want to say something in regard to the Steinmann nail in adults. We have only had a limited number of cases recently, but in the last several years at the County Hospital and in military practice the Steinmann nail has been used considerably. While there is, theoretically, objection to the use of the nail from the standpoint of infection, and because it has the appearance of a brutal method of treatment, on the contrary it is a most comfortable type of traction, and the element of infection so far has proved negligible. The pin or nail is used not so much through the condyles of the femur as it is through the os calcis, and it may be put in very readily under local anæsthesia. One makes a wheal, then a percutaneous injection of the local anæsthetic, and carries the needle down to the periosteum and beneath it. The periosteum is well injected before the tenotomy incision is made in the skin and the pin is grasped with ordinary artery forceps and conducted through the incision until it comes in contact with the bone and is knocked through with a hammer. Merely a local infiltration is made on the opposite side first. It is a good plan to have a sand bag or a piece of two-by-four, covered with sterile towel on the opposite side to take up the shock of the hammer blows. It is surprising how easily the nail can be put through the bone. In introducing the nail into the os calcis one runs no risk because of the absence of a medullary cavity in the solid block of the os calcis.

In the introduction of the nail through the condyles of the femur, one must be careful to avoid the epiphyseal line, for fear of interfering with the growth of the bone in a longitudinal direction afterward. It is desirable to put the nail on the shaft side of the epiphysis and yet to avoid the medullary cavity. The optimum time for the nail to remain in place is between 18 and 21 days. This is neither the minimum nor maximum time, but it is the optimum time for the nail to remain in *situ*. If the nail is allowed to remain longer than 3 weeks, there is danger of its cutting through, as a knife would cut through soft tissue, by the process of pressure necrosis. This pressure necrosis, if allowed to go on for a period of between 18 and 21 days, allows of easy removal of the nail without resorting to anæsthesia. One merely paints the protruding parts of the nail with tincture of iodine to render it as sterile as possible, because a portion of it has to be drawn through the wound in extracting the nail. Having withdrawn the nail, one takes a medicine dropper and squirts the nail hole with iodine and closes up the wound with collodion, and the limb is put in a cast.

There are one or two points about traction by the nail that I want to mention. One gets such excellent mechanical traction that there is danger of pulling the fragments apart, so that the necessary friction and irritation required to bring about enough hyperæmia to insure good callus formation may be lacking, because the fragments are pulled apart by the excellence of the traction. That is something to be borne in mind. In addition to that, one should, as Dr. Speed has pointed out, have frequent control with the X-ray, and with a portable machine that ought to be within the range of possibility in any well equipped hospital. The ordinary steel rods can be obtained in any hardware store, and it is advisable to get these of small diameter because a thick nail may split the bone, and because the wire loop, which makes traction, is applied close to the point of exit of the nail in the bone, there is not much possibility of the nail bending. Therefore, one does not need a heavy nail. The Steinmann nail by unscrewing the two ends can be drawn out and the infected portion is not carried through the wound. In a rather considerable number of cases we have had no infection.

It is a good plan in making the tenotomy incision, before the introduction of the nail, to make traction on the skin in such a way that after the traction is complete there may be no pull on the small incision, by the nail. This is easily done if one pays a little attention to detail. No matter how much

traction is put on, there will be no pain, so far as the nail is concerned, if one will use a wooden spreader to keep the wire loops from impinging on the soft parts. The traction is much more comfortable, generally speaking, when applied by means of the nail than it is in the ordinary way by means of adhesive plaster or with Sinclair glue. There is no excoriation of the skin. There is no pain connected with it, and the mechanical effect is to pull definitely upon the fragments whereas in making traction with Buck's extension it is exactly comparable to the pull made in pulling the leg by traction upon the trouser leg, the application of traction is not directly upon the fragment. I think nail extension occupies a mid position between the hazardous open operation upon bones and the frequently inefficient Buck's extension.

Dr. Edward H. Weld, Rockford, Illinois: I have been using the Steinmann nail through the os calcis for 6 or 8 years, but I have these nails made of highly polished steel. One end is so arranged as to fit in the drill. I have been using the nail in children from 7½ up to 8½ or 10 years of age. I drill a hole for the introduction of the nail and push the nail through, and have never had any trouble in cutting the bone. I have used it in twenty-five cases and have not had infection or any pain in its withdrawal. Sometimes I have used it in fractures below the knee; also in fractures above the knee and in combined fracture above and below the knee. In those cases in which it is necessary to put on a cast and secure ankylosis, the pull is so direct that it stretches the tendo achillis so much that when the nail is removed we have a nice ankle-joint.

Dr. Paul F. Morf: I have been much interested in Dr. Speed's paper inasmuch as I saw and treated a large number of cases of fracture of the femur in children while I had charge of the children's ward for several years at the Cook County Hospital.

Dr. Speed is hardly fair to himself in classifying these cases according to the anatomical results. A good many will show the clinical results to be excellent, and after all the clinical result is what we are after, regardless to a certain extent of what the anatomical relation of the bone may be. A slight disparity in position of the bone in children is comparatively less important than in adults, because if there is a slight angulation or overriding, the growth in the bone as the child matures corrects that to a great extent.

In my early days, when I had charge of these cases, we unfortunately had no portable X-ray apparatus, consequently it was out of the question to put up cases the way Dr. Speed does, even if we knew exactly how to do it.

In the latter part of my service I saw one or two cases that Dr. Speed had put up and I was anxious to try the method, but it seemed entirely unsatisfactory, as Dr. Speed has indicated, to put them in traction, and in 5 days take them down to see whether the bones were in position by sending them up to the X-ray room.

The method I have found most satisfactory is extension on a Hawley table. A method of treating fractures of the femur in a child frequently employed and which seems to be one of choice with new internes at the County Hospital, is to put the leg up in vertical extension. Vertical extension is entirely out of place in older children. Dr. Speed has made the limit 4 years. I prefer not to put up in vertical extension any child who is over 2 years of age. After that time a good result may perhaps be obtained. Before the age of 2 I think it is an ideal method.

Buck's extension is to my mind entirely inadequate. If we put a child up in Buck's extension carefully today, the chances are that when we go to see the child 24 to 48 hours later, every careful arrangement has been destroyed almost entirely, and Buck's extension might just as well not have been applied. My instructions are that all children under 2 years of age be put up in vertical extension. In those over 2 years we immobilize them by placing them on a Hawley table and applying a cast as soon as possible after they come in. A child should not be allowed to move around for 2 or 3 days without traction on. If early reduction is made and the child is placed in a cast, in many cases a good result will be obtained as far as reduction is concerned.

I agree with what Dr. Speed has said in regard to rapid development of callus. In a child with a fracture of the femur a large amount of callus is present at the end of 2 weeks and one is astonished, if later an open reduction is necessary, even when a patient has been put up on a Hawley table and a considerable amount of traction has been applied, to find that traction has not reduced the overriding to any great extent, and that considerable leverage and cutting away of callus is necessary to get the bones in alignment.

If a portable X-ray machine is to be had, it seems to me the application of continuous traction is much superior to the application of a body cast. I think the body cast is the next best thing when we cannot get a portable X-ray machine.

Dr. William Fuller: Since Dr. Speed mentioned the Lane plate in the treatment of fractures I would like to say a word on that point. The indications for use of the plate are growing less and less, especially in the minds of American surgeons. That it yet has a place, particularly in fractures of the more deeply seated long bones of the adult, can not be gainsaid. In some rare instances among the fractures just mentioned the Lane plate will serve the surgeon's purpose admirably; perhaps more effectively than will any device yet known.

The prompt and satisfactory healing of a wound covering a Lane plate provides or leaves no indication for its immediate removal. Should such indications remotely arise they will be outspoken and unmistakable and will leave no doubt in the sur-

geon's mind as to the proper course to be taken. Moreover, fistulous tracks leading to the plate with other evidence of its exact location, will make the operation comparatively safe and easy.

The removal of a Lane plate before it gives trouble may be a procedure more difficult than its introduction. In many instances it is completely covered by hard callus with no positive evidence as to its exact location which alone makes the finding of the plate very difficult. I have witnessed a failure to locate a plate covered by dense hard callus, and have seen by the X-ray, plates so deeply covered by new bone, that the surgeon would hesitate, without the best reasons, to attempt their removal.

I have a few patients, among adults and young people alike, whose fractures seemed at the time to call for the use of the Lane plates as they were popular at that time. Some of these plates have been in more than 10 years and have caused no trouble; and it would appear that their removal should be considered only when trouble arises; not before.

Dr. Speed (closing the discussion): We have had a number of children with rickets in this number, and no child with rickets has failed to develop callus normally and at the usual rate of speed. That is one observation we made during the year.

Do not understand from what Dr. Dyas has said that we use a Steinmann nail through the os calcis of children, because a child of 11 years of age has not much os calcis. There is nothing to put a nail through, and it would soon pull through to the fascia. It is all right in the adult. There are certain rules for using the Steinmann nail. If a fracture of the femur is reduced quite early on a fracture table and the cast applied, what will happen? Underneath the cast the muscles contract and continue to act. It is impossible to avoid that. You cannot put on extension in the longitudinal axis with plaster cast that will continue to act. If you put on enough to make the foot black as you are putting on the cast, what is going to happen? The circulation of the foot will be interfered with, so you will have to cut the cast. If you do not cut the cast, it will shrink and draw up, and you have no mechanical extension in the longitudinal axis with the cast. If you take a roentgenogram 2 days after reducing a fracture that has been placed in a body cast, you may have a fair result. Take a roentgenogram 10 days later, and see what you get. You have a resumption of the original deformity. The only exception is when the serrated edges have locked. Then you will not get shortening and overriding but an angular deformity. In using continuous traction, which the very best heads in the world acknowledge is the way of treating fractures of the femur, you have a constant fight against these muscles every minute. It lasts for days and days, and the callus forms, and after 3 weeks you can take the limb down and protect it from bending, and your maximum result is obtained. This is a short method, it is a sure method, and a controllable method. The portable X-ray permits constant checking of results.

With reference to the Lane plate, I have not used one on bones for years. I abominate them. They are all right for irreducible and long standing transverse fractures. I have put in a few that I thought would last 10 years, but they came out or were taken out after 5 years. I do not think a Lane plate has any use on a child's femur. If you can get a fair result by other methods, it is much better than putting in a Lane plate. I have not operated on one of this series of cases of fracture of the femur. In another series not yet reported all were operated upon. During my absence in Europe last summer one child in the ward was operated upon, with a fatal result. One other was plated with the result that the child developed a severe osteomyelitis, and it will take years for the child to get over it. No child has died in this series cared for by non-operative treatment. Some of the results have not been quite as good as they should be, but according to Wolff's law, the bone in most cases will mold itself and eventually there will be a fair functional result. The anatomical results are nothing compared with the functional results. If Lane plates are put on a child's femur, they should be left on for 6 weeks, for at that time callus will have formed and no further use of the Lane plate is needed. If a Lane plate is allowed to remain for 5 years you may have to take it out by chiseling away bone around it, but if you take it out at the end of 6 weeks, it will come out easily.

I am very glad to see that a conservative attitude has been taken in regard to the treatment of these cases. We have made a careful study of them. I have devoted an enormous amount of time to them and have given you the results as they really are.

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held December 17, 1920, Dr. Arthur H. Curtis, Presiding

RUPTURED UTERUS—ABLATIO PLACENTÆ

Dr. C. E. Paddock: While I hesitate to report a case without the laboratory findings—in each of these instances the specimens were unfortunately destroyed—I record the following cases, because of the infrequency of their occurrence:

The first case is as follows: Mrs. A. para-II, pregnancy at term, entered St. Luke's hospital in labor. The labor proceeded normally with the child in the first position, occipitolævo-anterior, head above inlet, heart-tones normal, and the membranes unruptured. After about 2 hours of seeming normal progress of the first stage of labor the patient was seized with severe pains in the abdomen, the uterine ovoid changed to an irregular mass, and the pulse became weak. The patient was removed to the operating room and the abdomen opened. The operation showed the fœtus partially in the abdominal cavity, the fundus fairly contracted, the placenta partially separated, and a tear extending through the left side of the lower uterine segment into the left broad ligament. I removed the fœtus, dead, did a hysterectomy, and the mother made an uneventful recovery.

The report of the second case is as follows: The patient was para-II, age 34, in labor at term, vertex presentation, fœtal heart-tones normal. Up to this time the pregnancy had been uneventful with the exception of an attack of indigestion about 3 weeks previous to the beginning of labor. The attack was followed by a slight trace of albumin, and a blood-pressure of 120-70. The labor began at 12:00 p. m. and I went to the hospital with the case. Labor, with severe pains, continued for about an hour, without effect upon the cervix. As the pains increased in severity, I gave nitrous oxid gas anæsthesia. The abdomen was tense and painfully tender to the touch, and a slight spurt of blood appeared at the vulva. I made a diagnosis of separation of the placenta. The pulse and general condition of the patient were not bad. With the least loss of time possible for preparation, I did a cæsarean section under gas-ether anæsthesia. After opening the abdomen I found the uterus very tense, and the incision let out a flood of blood, liquor amnion, and the placenta. I expected a dead baby, but artificial respiration brought it to, and it is now living. The mother's condition was for a time serious, owing to the hæmorrhage, but she finally made a complete recovery.

These two cases illustrate some of the pitfalls of parturition, and the necessity of the physician in charge being within immediate reach. When a child or mother, or both, are sacrificed in such cases it usually is the fault of the physician. If he is with the case he can make his diagnosis and meet the emergencies as they arise. Sometimes there are evidences that point to such a condition that helps one to make a diagnosis. Often a prolonged labor with a disproportion between the head of the child and the pelvis, or a malposition, or malformation of the fœtus will cause a rupture. But sometimes, as in these two cases, there is no indication of the condition until the last moment and if the physician is not with his case he will lose one or both of the lives intrusted to his care. So let me repeat for the benefit of the student of obstetrics; have your case in the hospital under your observation, from the beginning of labor to its termination; and after 30 years of practice you may see a case like the second reported; if you do, and if you save both mother and child because you're on the job, you'll have something to be grateful for!

TUBERCULAR INFILTRATION OF INTESTINES

Dr. Albert Goldspohn presented the reports of two cases together with the specimens, the terminal ileum, cæcum and ascending colon, which were removed in each case for extensive tubercular infiltration and ulceration. Both cases present interesting clinical features. The first case, a nurse in training, age 28, had had the cæcum, appendix, and 8 inches of ileum removed for tubercular disease, at the Mayo Clinic 6 years previously; a year later, she was there aspirated twice for pleuritic exudate. After that, it seems that her health became fairly good until about a year preceding this second operation upon the colon. The leading symptoms during that year were constipation with pain alternating with diarrhœa, occult blood that later frequently became grossly visible in the stools and progressively increasing anæmia and emaciation with a hectic temperature. A local tumefaction was palpable. At the previous operation an end-to-side anastomosis with a Murphy button had been made between the ileum and ascending colon, at a point some distance from its closed end, thus making a new cæcum. This had become much enlarged in depth and width. Its walls and mesentery were much thickened; and in its bottom were large tubercular ulcers covered with blood. The button anastomosis had resulted in a stenosis with a corresponding dilatation and hypertrophy of the proximal ileum which was larger than the upper portion of the ascending colon. After extirpation of the secondary large cæcal pouch, 6 inches in depth, with 6 inches of ileum and 4 inches of ascending colon, I made an end-to-side anastomosis with a

Murphy button between the ileum and transverse colon according to an ingenious suggestion of Dr. Charles Mayo, in which the closed end of colon and the stitches that chiefly secured its closure were adjusted extraperitoneally but within the layers of the abdominal wall in the upper end of the incision in such a manner that they could become accessible beneath the skin and superficial tissues, in case it became desirable to open them up to relieve distention from gas that chiefly endangers anastomoses upon the large bowel during the after-treatment. The case progressed normally until the ninth day, when, after an enema, this tentative closure of the colon gave way and most of the intestinal contents were discharged at that point for four days, when the normal passage was resumed and successfully assisted for a time, by plugging of the fistulous opening with firm bismuth paste. After that, the case progressed normally, except that the Murphy button did not come away. X-ray showed it lying in the bottom of a downward bend of the transverse colon; and it would not ascend with the fæcal current to pass through the normally fixed splenic flexure of the colon. After observing this for nearly 2 months I took it out by special incisions. After that, the convalescence was smooth; and the patient has recovered good health.

The second patient was a girl, age 23, a stenographer. She was sick several months before operation. The leading features during the last 6 weeks of this time were very defective alimentation, blood in the stools all the time, and sometimes plainly visible, hectic temperature, marked anæmia, local tenderness and a palpable tumefaction. Hospital care and feeding did not improve her condition enough to warrant undertaking a formidable operation, until about 8 ounces of pure whole blood had been transfused into her three times at intervals of 2 to 3 days, by Dr. Abelmann. This stopped the bleeding and improved her condition markedly. The operation was then ventured in which this other specimen was obtained. It consists of 4 inches of terminal ileum and 13 inches of cæcum and ascending colon. It shows many ulcerations in these parts with much thickening of adjacent wall of the bowel. Enlarged glands were numerous in the mesentery and miliary tubercules abounded. An end-to-end anastomosis with bicircular enterorrhaphy was made between the ileum and transverse colon and enveloped with omentum. Danger from gas distention was guarded against in this case, by a soft-rubber tube with about a half-inch lumen, that was passed up the rectum through the sigmoid and descending colon into the transverse colon, and held there for 10 days. Regular feedings with about 8 ounces of normal salt-solution with glucose through this tube about every 4 hours, kept its lumen from becoming clogged; and it served quite satisfactorily as a vent for gas. Convalescence in this case was slow chiefly owing to remnants of tubercular infiltrations and enlarged glands in the root of the mesentery that could not be removed, and also owing to a late secondary opening and discharge from a part of the primarily healed wound, from infection of the same kind; but after 8 months she had gained quite good health.

ABELMANN METHOD OF BLOOD INSTILLMENT

Dr. Henry W. Abelmann: Being the originator of a new method of transferring blood as well as of a new method of testing its compatibility (biologically), I have naturally had considerable experience in transfusion work. Finding the word blood-transfusion not so applicable to my way of transferring blood, I prefer to have it known as the "Abelmann Method of Blood-Instillment." The reason for making this distinction is that by this method the recipient as well as the donor is safeguarded by giving and taking only small quantities of blood (120 cubic centimeter), at regular intervals (4 to 6 days), and also by testing for the blood compatibility by a clinical (biologic) test rather than by laboratory means (blood-grouping). My test consists in a trial introduction of a few drops of blood and then waiting and carefully observing for a number of minutes for any abnormal phenomena that usually appear at once in cases of incompatibility before harmful amounts of blood have been introduced. According to the recorded experience of other operators, the laboratory tests have not been so reliable in guarding against fatalities; while this blood-instillment is a safe and simple procedure and brings about better therapeutic results. As to the hæmostatic effect, I had the case of a physician who was operated upon for tuberculosis of the mastoid, accompanied with tubercular lymph-glands of the neck as well as tuberculosis of the lungs. The patient seemed in a dying condition when I was called to see him, as he had developed a pulmonary hæmorrhage a few days after the operation. I instilled blood which stopped the bleeding almost at once, and repeated it six times at regular intervals. Six weeks after blood instillment the mastoid was healed, the lymph tumors had disappeared, and the patient gained much in weight and strength, with marked improvement in the lung condition. Another equally interesting case of this kind is that of repeated hæmorrhages into the retina. I was called in at a time when all other means had failed and the patient was already blind in one eye from detachment of the retina. The blood instillment again proved its worth in checking the hæmorrhages as well as in saving the sight of the eye. I could cite numerous other cases if time would permit; but in closing I wish to observe that I think my method is one of the safest, as I have never had a fatality from blood incompatibility in over three thousand blood instillments.

DISCUSSION

Dr. Arthur H. Curtis: I would like to know whether in the last patient in whom Dr. Gold-

spohn did an end-to-end anastomosis he invaginated the portion of the bowel that was anastomosed? Second, were the bowels permitted to move within 2 or 3 days, or were there no movements through catharsis for a considerable time?

Dr. A. Goldspohn, closing discussion: Answering the inquiries of Dr. Curtis, I will say that no invagination was made in connection with this circular enterorrhaphy. The difference in size of the two bowel openings was not great. It was overcome mostly by cutting the end of the smaller one on a bevel and by placing the stitches on the side of the large bowel a trifle farther apart than on the other side. Regarding bowel movements after operation: nothing was done to invite them for about 12 days aside from the fæcal matter that was discharged with the gas and water through the tube in the bowel, that was regularly flushed out with normal salt-solution and left uncorked about half of the time between the feedings.

TRANSPLANTATION OF OVARIES

Dr. S. S. Schochet: I wish to record two observations on the transplantation of ovaries. In the eye of this pregnant rabbit is a transplanted ovary (a quadrant) which shows no evidence of ovulation. This concurs in part with the theory of L. Frankel. The second specimen is an artificially fertilized ovum, from a transplanted ovary and tube, an ectopic pregnancy. I simply wish to record this work with the hope of being able to present a more detailed report at a later date. There are a number of factors that have not been made clear, and explanations at this time would only cloud the problem.

RUPTURE OF THE UTERUS

Dr. D. S. Hillis: I wish to report a case of rupture of the uterus and show this specimen, partly because of its rather unusual interest and partly to illustrate the efficiency of the cæsarean section scar in the operation first done by our colleague, Dr. Charles E. Paddock.

The patient is a colored woman, 36 to 38 years old, with a history of two spontaneous deliveries. One year ago she was delivered by cæsarean section at St. Luke's Hospital by Dr. Paddock. She was admitted to County Hospital 3 days ago, pregnant at term, with the uterus in tetanic contraction. There was extreme tenderness over all the abdomen and it was impossible to make out the fœtal parts. The patient was in shock and no labor pains were present. Two internes observed heart-tones at the rate of 144. A diagnosis of threatened rupture of the uterus was made. The patient was given a full dose of morphine. When I saw the patient an hour later, diagnosis of threatened rupture of the uterus was confirmed. Upon catheterization at this time, the first show of blood appeared at the vulva. Heart-tones were not listened for on account of the urgency of the situation. An incision was made through the mid-line and a considerable number of adhesions were found, indicating a previous peritonitis. When the abdominal cavity was opened free blood was found. The anterior wall of the upper part of the uterus was normal, but at the junction of the lower uterine segment with the body of the uterus a tear was found, extending from a little to the right of the mid-line toward the left into the broad ligament. The left broad ligament contained a hæmatoma, about the size of my fist. Through this opening the hand passed easily into the uterine cavity where fœtal parts could be felt. No cæsarean section scar was visible on the anterior wall of the uterus. A dead baby was removed through an anterior incision, and there was some difficulty in getting the head up through a contraction ring, just above the lower uterine segment. The baby weighed about 8 pounds.

I do not know the cause of the rupture, as a clear history was not obtainable, and the pelvis showed no marked contraction, neither is it clear exactly when this uterus ruptured. I do not know the indication for the previous cæsarean section; whatever it was, it was evidently a valid one. I am unable to find any sign of the scar of this previous cæsarean in this specimen, and it is to emphasize the point that the uterine scar did not rupture that I report the case.

DISCUSSION

Dr. Charles E. Paddock: Dr. Hillis' remarks might give one the impression that there was something wrong either with my technique or judgment in operating upon the case he reports. I cannot recall the case now but I think he will conclude that I had good and sufficient reason. He says he does not know why the uterus ruptured and the fact that it ruptured, but not through the old scar, vindicates me because there must either be a contracted pelvis or some obstruction to the inlet.

Dr. N. Sproat Heaney: This is an extremely interesting case. The old cæsarean scar held and the rupture occurred where rupture of the uterus is predisposed to occur—in the lower uterine segment. I would like to know if Dr. DeLee thinks that the patient might not have had a rupture if the cæsarean had been performed in the lower uterine segment the last time, or whether the rupture would have been larger or if it would have been influenced in any way by having had a lower uterine segment cæsarean section instead of a classical.

Dr. Joseph L. Baer: I should like to bring before the Society the name of our late lamented member, Dr. Stowe who often spoke of the lower uterine segment as the most frequent point of rupture. That, I think, conforms to the literature in general. We have learned in late version where there has been loss of liquor amnii for some time and we still feel justified in the attempt, to pass a hand up on the side of the occiput and allow the hand to remain as a splint for the thin uterine wall, we thus prevent

the occiput from rupturing through the weak spot, that is, the lower uterine segment.

Dr. Joseph B. DeLee: There have been several thousand vaginal cæsarean sections performed and several thousand transverse peritoneal cæsarean sections performed. Up to date I have been able to find only two cases of rupture of the uterus reported. In these two cases the portion of the scar that was on the fundus uteri ruptured but nowhere else. A third typical case was reported where after low cervical cæsarean a rupture of the uterus occurred, but not in the scar; it was in the same location as in the case reported by Dr. Hillis, at the side of the uterus. In other words, the scar held.

Dr. Theodore J. Doederlein: I had occasion to do a cæsarean section in a case where there had been previous section and the scar held tightly; so the rupture does not often occur in the scar.

SEQUELÆ AND LATER ASPECTS OF TOXIC ALBUMINURIAS OF PREGNANCY

Dr. Harold K. Gibson read a paper entitled: "The Sequelae and Later Aspects of the Toxic Albuminurias of Pregnancy. (See p. 513.)

DISCUSSION

Dr. C. S. Bacon: I am particularly interested in the question of the development of the kidney lesions during pregnancy. I have discussed this matter with Williams several times but have not been able to agree with him in his position that the continued presence of an albuminuria shows that a nephritis existed before the pregnancy. Because of Williams' position in the matter I have given most careful study to all cases. In some cases there was, during childhood, the possibility of nephritis from scarlet fever or other illness, but in a number of cases where kidney examination was made before the pregnancy, there was no sign of kidney lesion, and as the kidney lesion remained after the pregnancy I feel perfectly convinced that it was developed during pregnancy and remained afterward. Now that is, I believe, an important factor in the question of prognosis, as to its possible existence in future pregnancies. In those cases in which all of the kidney symptoms cleared up during the puerperium there is undoubtedly the same danger of eclampsia in subsequent pregnancies, as there was before. But all these facts by no means lead to the conclusion that subsequent pregnancy ought to be prohibited. They simply lead to unusually careful observation and care of the patient during pregnancy. That is, to me, the most important point.

Dr. Theodore J. Doederlein: In my immediate relationship I have two cases of albuminuria, and one of the patients had very severe convulsions the first time. Since then they have both had children. The question arises, would it be justifiable to allow these women to go through another confinement? The probability is that both of them will have to undergo an operation for retroflexion and I am wondering whether it is justifiable to sterilize them. Both of them have had what seem to me toxæmia headaches and I am much in a quandary as to the advisability of sterilization. They are both young women, one with 3 children, the other with 2, and they would not like to be sterilized unless it is absolutely necessary. In other cases I have had repeated pregnancies after severe eclampsia and albuminuria, but the toxæmia headaches are always there.

Dr. Emil Ries: If it was at all necessary to emphasize our present state of insufficient knowledge of albuminuria or nephritis in pregnancy I think Dr. Gibson's paper did that very successfully. In the course of his paper the terms "nephritis," "albuminuria" and "pregnancy kidney" have come up as if they were interchangeable. They should not be. Albuminuria and nephritis are two different things. Nephritis might produce albuminuria, but albuminuria is not necessarily connected with nephritis. Further, albuminuria is not necessarily a forerunner of eclampsia.

I would like to see emphasized more that as a rule little or nothing is known about the kidney history of the pregnant woman when she first comes for an examination. If, during the examination, albuminuria and casts are discovered in that woman's urine it is difficult to tell whether the condition arises during pregnancy or whether it was present before. If you look at the history of chronic nephritics you do not, as a rule, find that they have nephritis every day of their life for years and years. They often have long periods of apparent health. If a woman does show some albumin, there may not be any albumin in her urine at other times and unless the condition of her urine has been investigated on previous occasions, the first examination during pregnancy often leaves her true condition uncertain as to pre-existing nephritis.

I wish to emphasize again what Dr. Gibson has emphasized, that the really chronic nephritic hardly ever becomes an eclamptic. And there is another thing which is important and apparently certain, which I have had occasion to confirm myself in examinations made 31 years ago concerning the urine in pregnancy. Thirty-one years ago I wrote a thesis on nephritis in pregnancy and tried to work up the patient's history before the eclampsia. I worked in an institution where they received pregnant women for months and months before confinement, and where we had an opportunity to examine the urine daily, 24 hour specimens if necessary. Out of the hundreds I examined at that time there was just one who showed albumin 3 days before confinement and had eclampsia. One other woman developed albuminuria and eclampsia during the labor and was absolutely free until labor. Of all the nephritics, of all patients who had signs of chronic nephritis on numerous examinations before the labor, showing urine with albumin and casts and sometimes blood, none became eclamptic. I

can also state that those who were nephritics before labor were nephritics afterward, that those with eclampsia were free from albumin the day after labor, and subsequent examinations weeks afterward showed no damage to the kidney, that those who developed what was called in those days "pregnancy kidney" and who did not develop any eclampsia, as a rule showed no more albumin or casts after the puerperium, while only one continued to show casts and albumin at times. This last one was a patient in whom we could not be sure whether she had been a nephritic before she became pregnant.

One of those who had eclampsia went through labor 2 years afterward without eclampsia. Therefore, eclampsia once does not mean eclampsia the next time. I think we do not know what albuminuria in pregnancy means, that we do not know what a "pregnancy kidney" means. A woman may develop albumin in labor, but it is also well known that epileptics are apt to show albuminuria after attacks. All this is important, but there is a tendency—as was so well brought out in Dr. Doederlein's discussion—to draw conclusions from insufficient evidence. For practical purposes it must be stated that if we do not know whether albuminuria is apt to recur we do not know what our attitude should be in regard to the future of the case. If we know that a woman with albuminuria during pregnancy and labor is not apt to have it in the next pregnancy we should not deny her a subsequent pregnancy. As a matter of fact, the larger the series of cases you observe the fewer cases you find where a woman is eclamptic twice.

I have heard so much about the treatment of "pregnancy kidney" and albuminuria, and it has seemed to make so little difference that I have become a skeptic. It might almost seem that eclampsia is an infectious disease; it is a disease that is associated with fever; it occurs in groups like an epidemic; it is a disease that is usually self-limited, whether we treat it or not. It is a disease that is associated with changes in the kidney such as you find in any acute infectious disease—you can find the same kind of albumin, and the same kind of casts and the same kind of blood. The fact that it is associated with kidney symptoms does not mean that the kidney is the cause of the disease—any more than the kidney changes are the cause of scarlet fever, just because the patient may have albuminuria during scarlet fever. It is quite conceivable that the eclampsia and the kidney changes are due to a common cause.

Dr. Rudolph W. Holmes: The more I view the matter of the toxæmias of pregnancy, the more skeptical I am that there are typical pictures of albuminuria, kidney of pregnancy, and eclampsia. There are undoubtedly many substances produced by the pregnancy which may cause troubles producing the symptom-complex of these three, now considered, entities: that they are distinct entities, or merely phases of one and the same disease, is still a moot question in my mind. *A priori*, there must be a number of complex substances produced in and by the pregnancy which cause the diseases above mentioned. On a number of occasions I had almost convinced myself that I had one or the other of the lesser complications by the train of symptoms only to be disillusioned by the manifestation of eclampsia. I am sure all have had that experience. A precision in diagnosis only will come by the proven isolation of the offending factor.

I have a very definite conclusion that of those eclampsias I have had, or those who had eclampsia in previous pregnancies attended by other physicians, went through their subsequent pregnancies and labors without recurrence. I have had only one woman who had a recurrence, and she had a prævia and toxic symptoms in her first pregnancy; a marked toxæmia in her second, necessitating an interruption after the seventh month; in her third pregnancy, symptoms developed so early that it was necessary to empty the uterus by the third month; and in her last pregnancy she had marked toxic findings which demanded a premature labor, saving mother and child. The infant weighed just under 3 pounds. My conclusion is that eclampsia does not predispose a woman to the same malady in subsequent labors. On the other hand, the so-called kidneys of pregnancy and albuminuria, tend to persist for protracted periods after the termination of that pregnancy, and the kidneys retain so little resistance that in subsequent pregnancies the trouble is prone to recur.

As I remember, Richardson, medical director of Harvard University, made an exhaustive report on the physical findings of all men who had entered strenuous athletic competition. Pertinent to this question, he reports that practically all the crew men, and others who perform the hardest stresses, manifest an acute irritation of the kidneys, manifested by albuminuria with a shower of casts, after their endeavor. To an extent this is likewise true of women who go through the severe test of a hard protracted labor. We have had much advice as to the necessity of the routine examination of urine during the months of gestation, but sufficient emphasis has not been placed on the advisability of a routine urinalysis postpartum. I do not question that such findings in a woman recently delivered, and who was normal in pregnancy, has not a toxæmia but manifests an expression of the kidney irritation from the products of combustion incident to the hard labor, plus the elimination incident to the retrogressive changes going on in the uterus.

In conclusion, my experience has not been in consonance to that of Dr. Gibson; namely, that a previous eclampsia peculiarly predisposes the woman to recurrences.

Dr. Charles E. Paddock: If I understood Dr. Gibson correctly he makes too light of mild albumin in pregnancy and does not consider it a dangerous factor unless persistent, that it is a common occurrence, that albumin with or without casts is often

found, and no bad results follow. Admitting that fact, such findings are to be looked upon with all seriousness and prompt treatment instituted.

It is stated that albumin is found in the athlete after a race. The pregnant woman can in a way be likened to the runner in the Marathon. Her every organ is not only occasionally but continually called upon to do extra work, and the result is a damaged kidney.

In just what percentage of pregnancy cases we find albumin I am unable to state, but I believe in a larger percentage than usually quoted in the text-books. Fortunately, it is not persistent but nevertheless it is a danger signal.

With albuminuria persisting there will soon be added increased arterial tension, and when we find this increase in the blood pressure, plus albumin and œdema, the patient is in a very dangerous condition and is in what is called the pre-eclamptic stage.

The term "kidney of pregnancy" I do not like. To the average physician it means a physiological condition when really it means a beginning damage to the kidney.

Fortunately the number of cases of albuminuria and eclampsia, in the practice of the physician who sees his cases early in the pregnancy and carries out the hygiene of pregnancy, are less common than formerly. If Dr. Ries was as active now in obstetrics as he was 20 years ago he would find this statement correct. We get our patients earlier, they understand the importance of pregnancy hygiene and the physician has a much better control over his patient because of it.

The sphygmomanometer has been a very active factor in detecting early functional disturbances of the kidney due to pregnancy, and since it has come into practical use I have relied more upon its readings than upon other findings. An increasing blood pressure in pregnancy is usually accompanied by damage to the kidneys.

The treatment of eclampsia has been mentioned in the discussion. While the paper does not refer to the treatment of eclampsia, I may say that the treatment has not changed much in the last 25 years, except in the abandonment of the use of chloroform at the convulsion stage. There is no doubt but that the use of chloroform raised the mortality.

I agree with the essayist that a woman suffering from albuminuria in a pregnancy usually becomes a nephritic and subsequent pregnancies are to be watched with unusual care.

Dr. N. Sproat Heaney: Anyone would be of great service to us who would give us a fair picture of the various types of intoxication that have been mentioned in the paper and in the discussions.

Dr. Jos. B. DeLee: I don't know anything about the causation of eclampsia; that is the reason I came here tonight. Years ago I thought I did know something about it, but I have found my cases so mixed that I have lost confidence. In a general way I think we can distinguish between the liver type and the kidney type of eclampsia. They are clinical terms, not pathological except in so far that when we see a woman with an acute onset of coma with or without convulsions, if there is jaundice, and when the renal findings are either of less importance or late in development, if the woman has a great deal of delirium and the case is very serious from the start, I have usually called those the hepatic type, because at the postmortem the liver is the most involved. The nephritic type is represented by those cases that have been long in coming on. The women have had albuminuria, and here the blood pressure is high; it is not likely to be so high in the hepatic type. The kidney findings are very pronounced and earlier, the convulsions are more numerous and last longer, and the prognosis is not so bad. Usually in those cases you have the history of scarlet fever in childhood, or frequent attacks of tonsillitis, or some reason to believe that the kidney was damaged. These cases we call the nephritic type, but I have never been able clinically, by blood examinations or urinalyses to determine which was at fault. It is not possible to say that in all cases the kidney only or the liver becomes involved.

There is another type, the "reflectoric" type. A woman will go on in labor for a certain time, and then, just as she goes to deliver will have one convulsion. We see the same thing in children. We sometimes call it teething, but there is something else of course. Beyond question, the nervous system has something to do with the development of these seizures and probably the liver is the cause of the reflex type of eclampsia.

As to the question that Dr. Gibson brought up—is there any permanent damage to the kidney from eclampsia, I would not know how to answer that. I have followed up my women who have had eclampsia, very carefully, and women who have had the simple type of convulsions have gotten well afterward and have had babies. On the other hand, the women who have had what I term the kidney type would almost always have a high blood pressure, the urine would show albumin and casts diminished and urea, or other evidence that there was something wrong with the kidney and arterial system. I would say that in the acute cases, as Dr. Ries has said and as I have always believed, and as several have very strongly held, eclampsia is an infectious disease. The woman gets over it and has little or undiscoverable damage to the kidneys and liver.

I think we can distinguish pretty well between those conditions we call chronic nephritis and those we call eclampsia.

Dr. Joseph L. Baer: In Dr. Gibson's very excellent analysis of his series he laid particular stress upon hypertension as one of the cardinal points in the danger signals. I think it well that attention be drawn to hypertension as one of the danger signals, but I prefer to emphasize the fact that every little while a woman will have an eclamptic seizure with-

out ever having shown any evidence of elevation of blood pressure. I call to mind two women whose highest pressure, taken immediately before the seizure, was 120 systolic and surely with 120 systolic pressure the danger signal so far as tension is concerned would not be apparent. Hypertension would be a warning, of course, but the absence of hypertension should not leave a sense of security.

As to the presence of two types of eclampsia to which Dr. De Lee referred, I think in outlining the symptoms he indicated very properly that there is a distinct pathological difference in the two types. The nature of that difference we do not know, but the pathological findings indicate a very definite grouping into the hepatic and nephritic type. The hepatic, with little or no hypertension, with a urine which is highly colored, a brown urine, sometimes showing only a very faint trace of albumin, in my experience has been the fatal case of eclampsia. I am a little at variance with Dr. DeLee's findings in that respect, for it has seemed to me that the nephritic type, which is the more favorable so far as outcome is concerned, has shown a complete clearing up postpartum, whereas the hepatic type has usually succumbed and there has been no opportunity for a postpartum study.

Dr. Gibson sounded a note of pessimism as to subsequent pregnancy, to which I would like to take exception. I have knowledge of only two cases of a second eclampsia following a first, those two out of a very considerable number of eclampsias, and I believe that it is a mistake to prohibit pregnancy to an eclamptic. I think the vast majority of eclamptics will go through subsequent pregnancies, under careful watching, and will not sustain any damage comparable to what Dr. Gibson indicates is his fear.

Dr. Carey Culbertson: In view of the expressed ignorance of the previous speakers as to what eclampsia is and is not, I think we might all agree that we do not know what eclampsia is and limit the discussion to what we believe, or think, regarding Dr. Gibson's paper. In his remarks he discussed the systemic reaction to pregnancy with special reference to kidney changes. If we discuss it from that point of view, we will avoid using the terms "kidney of pregnancy" and "nephritis." His paper and his very elaborate tabulation bring out two things which I believe are of clinical importance with respect to the general systemic reaction of pregnancy as expressed by kidney changes. The first is this, that no patient showing albumin and casts with or without eclampsia, that is with or without convulsions, in pregnancy, practically clears up on treatment. They improve; the blood-pressure can be reduced; they get better but they do not get well while the pregnancy lasts. The second is this, that no kidney can go on producing casts for any considerable length of time without being permanently damaged.

Dr. N. Sproat Heaney: Since we have started to use the blood-pressure apparatus, I feel that we have learned a great deal regarding the course of an albuminuria and also its subsequent prognosis. I think considerable confusion arises from trying to differentiate various types of eclampsia just the same as if we would try to differentiate different types of typhoid fever. Though we do not know what eclampsia is, I think that frequently we can give our patients some very definite advice regarding future pregnancies. It has been said that if a patient has persistent albuminuria after eclampsia, it is dangerous for her to become pregnant. That may be true. I, however, have never seen a case which had albumin in the urine 6 months after the eclampsia. Certain cases have eclampsia afterward although the albumin does not persist after the eclampsia for very long. If a patient, however, has a slow return to normal blood-pressure and has a residual blood-pressure of considerable amount, I think she is a bad risk for a subsequent pregnancy. If a patient has a blood-pressure of 160 or 170 for months after her eclampsia, that patient certainly runs a very grave risk in becoming pregnant again. She will not be able to carry the child to viability before she is overwhelmed with intoxication. That is quite certain. The patient who has an eclampsia and goes through subsequent pregnancies without elevated blood-pressure and albuminuria is the patient in whom the symptoms in her first pregnancy came on rapidly just before delivery, and who had a quick return to normal blood pressure and normal urine after delivery. We cannot, however, say that such a patient may not have an eclampsia or run severe risk in her subsequent pregnancies, but those who do go through nicely belong to this class of cases.

Dr. C. S. Bacon: I believe that this discussion might have been a little more satisfactory if Dr. Ries in his remarks had gone more into the subject of the changes in the kidney. I suppose it is well agreed to by all that the changes which are found in the cases of eclampsia are changes in the epithelium of the tubules. It is very difficult if not impossible to draw a dividing line between the so-called kidney of pregnancy where there is cloudy swelling and that where there is a distinction of tissue. We rarely have in these cases such changes as we have in acute infections like scarlet fever; that is, changes in the glomeruli. The important question is how much harm has been done to the tubules. How many tubules have been destroyed, how much of the kidney has been put out of use, and in how many of the cases has the disturbance gone on to the glomeruli. I believe that the extent of the injury may be so great that the nephritis or albuminuria may be permanent. If that is the case, the question arises: Is it more apt to be the case in women who have recurrent eclampsia?

I am surprised that so many have seen no cases of recurrent eclampsia. I supposed it was a rather common occurrence, and I think it would be valuable if the total experience of all could be obtained.

Dr. W. George Lee: The only comment I make is that this discussions show the remarkable need of a nomenclature that corresponds to what we have in mind. I have been interested in hearing eclampsia spoken of as both with and without convulsions as equivalent to toxæmia, and a large number of different terms used interchangeably at haphazard. It seems to me that to have definite comparable ideas on the subject we should so qualify our terms that we know we are talking about the same conditions.

Dr. Joseph L. Baer: I think we should note that Dr. Gibson's series of 30 contains 15 cases of eclampsia.

I neglected to emphasize a point about hypertension that I try to make clear to students in discussing this subject. The patient with a high pressure may go through a normal pregnancy where another with only 120 may get eclampsia. If a woman starts with 90, and jumps to 120, to me that is as definite a warning as 140 or 150 found at the first examination. It is the increased systolic pressure that I take to be the serious danger signal.

Dr. Arthur H. Curtis: I wish to emphasize that the presence of casts may depend upon how soon the urine is examined. They sometimes disappear very promptly. I have in mind a woman in the service of Dr. Holmes who had an almost complete anuria for about a week. It was decided to catheterize the ureters in order to stimulate the secretion of urine. We catheterized and found no casts in the bladder urine, but that obtained through the ureteral catheters was almost solid with casts. Immediate examination will often reveal casts, whereas if the examination is delayed a short time they disappear.

Dr. Harold K. Gibson, (closing the discussion): In reply to Dr. Ries relative to the significance of albumin *per se*, I can recall no reports in the literature of an eclampsia without albumin. Zangemeister in an enormous material has seen no case without more than the physiological amount of albumin in the urine. Dr. Lee, I believe, holds that every pregnant woman with an albuminuria, irrespective of the amount, is a potential eclamptic, a view in which I must concur. As Dr. Ries has said, the etiology of albuminuria we know nothing about, but surely this is not a reason for optimism where a repetition of the pregnancy in the type of case presented, is concerned. On the contrary our lack of knowledge of the etiology of this group of affections should, I believe, make us the more conservative. I have been able to find but little relative to a subsequent pregnancy in these cases in our literature. Indeed, it is improbable that any considerable number repeat the pregnancy, but I must remind Dr. Ries that of our 30 cases, all of the 7 who subsequently became pregnant manifested renal disturbance of varying intensity. I believe that irrespective of the question of a later pregnancy, we can demonstrate that not a few of these women suffered irreparable damage through kidney and myocardium, a hazard which must be given a full measure of consideration. It should be borne in mind that several of these women examined months postpartum showed an absence of albumin and casts, but a systolic pressure of 148 and a diastolic of 90 or above. Personally, I would be interested in knowing how many eclamptics and pre-eclamptics could get a standard life insurance policy 5 years postpartum.

The doctors' criticism of the terminology is merited. It would appear that everyone writing upon this subject has his own, and the end is not yet. I believe the remarks of Dr. Holmes relative to albuminuria are covered in my reply to Dr. Ries. If Dr. Baer will refer to the chart, he will find that two of our eclampsias were admitted to the hospital with a normal arterial tension, both developing convulsions within 24 hours, with a corresponding rise in the arterial tension. The doctor, I believe, misinterpreted my position upon subsequent pregnancy. Although I will plead extreme pessimism there are undoubtedly women who repeat the pregnancy without hazard, but I believe their selection would need extreme discrimination. The doctor of course, understands that I refer to the more severe type of these cases as characterized by a hypertension, also I would again insist that contrary to the view held generally, freedom from albumin after delivery for a period of months is, *per se*, no guarantee of immunity in a future pregnancy.

Dr. De Lee spoke of the different types of eclampsia—a subject I am not prepared to discuss. It would seem to me vastly more important to reduce to a minimum, eclampsia in general, by an early differentiation between those cases of simple albuminuria with œdema, or Leydens' kidney, and the eclamptic or inflammatory type as characterized by hypertension plus hæmaturia. Recent pathological research is demonstrating distinctive inflammatory changes in the glomeruli in this latter group. To Dr. Doederlein's question concerning the wisdom of sterilizing the eclamptic woman with a family, in the course of an operation for other cause, I would say—certainly, by all means.

AMERICAN COLLEGE OF SURGEONS

SOUTH AMERICAN SURGEONS

Report of Official Visit to Brazil in Behalf of the American College of Surgeons, by Franklin H. Martin, M.D., Chicago

Foreword

In January and February of 1920 Dr. W. J. Mayo and the writer visited Peru, Chile, Argentine, and Uruguay. At that time we were unable to make satisfactory traveling arrangements for a trip to Brazil, the largest of all of the South American countries, having an area equal to that of the United States, and fully as much territory as the four other countries in South America which we had visited. This year Dr. Thomas J. Watkins and I were more fortunate, and inasmuch as no report on Brazil has previously been made, that country has been selected for the first article of this series.

We have long been aware of the high reputation accorded to the medical profession of Brazil. Through correspondence we had learned something of their institutions, and through the visits of some of their men to the United States we had become personally acquainted with a few of them. But it was with unusual curiosity and with no little anxiety that we looked forward to meeting them in their own country and in their own environment. Our visit included the capitals of the two principal states—São Paulo and Rio de Janeiro. We deeply regretted that we could not visit the other medical universities, particularly those at Bahia and Pernambuco.

The professional man perusing this sketch may criticise it for its details pertaining to some of the impressions gained by travel in a tropical country that it so different from our own country; but one must be adamant to travel in Brazil and not be fascinated by its wealth of physical beauty and the charm of its interesting people. Therefore, at the risk of tiring the reader by details, and in order that he may see things as they appear to the casual traveler in obtaining his first bird's-eye view, I shall quote extensively from my log written from day to day, supplementing, where necessary, with additional notes.

I. Santos, Guaruja

1. Montevideo to Santos

March 9. Montevideo. Embarked on the SS. Aeolus for Santos, Brazil. Parted with our many friends of this attractive city. Sailed at 3 p. m. Minister Jeffery, our Uruguayan Minister, with his family, were on board en route for the United States. After a strenuous but most interesting week in Montevideo, the prospect of a three days' rest at sea was most welcome.

March 10. Long deck walks. The sea was smooth and blue, with a delightful breeze blowing and an agreeable temperature. Our prow was turned toward home and we had before us three weeks' exploration of a new country.

March 11. Met and conversed with Mrs. Lindsley, the daughter of Ambassador Stimson of Argentine, who was returning to New York. Her impressions of the people of Argentine are most gratifying. Had a long deck hike and conversation with Minister Jeffery. He is a lover of the people of Uruguay, and gives interesting sidelights on their character.

2. Santos

March 12. Land reported in sight. Directly ahead of us appeared early in the morning a number of mountain-hills which resemble the old conventional bee-hive, cone-shaped, with rounded apex. Between two of these, which stand like sentinels, we steered our ship and passed in among a group of them ranging in height from one thousand to two thousand feet. Their dome-like tops appeared rocky and bare, but their bases were covered with a wealth of green. We were soon following an opening which wound about between the hills like a broad river, and discovered very shortly that this inland passage was the important harbor of Santos, the greatest coffee export market of the world. As we drifted into the harbor through its narrow approach, we passed light-houses, little hamlets with red tile roofs, and for the first time viewed a wealth of

tropical growth that thoroughly satisfied us. It met the standard of the conventional ideas gained by description and pictures. Lofty royal palms projected above and lent dignity to a mass of feathery green foliage, in which were great trees covered with a purple, azalea-like bloom, and a riot of colors produced by other unfamiliar trees and growth.

We came to anchor off modern docks like those at Colon, and at noon were conveyed by tender to the shore where a little narrow-gauge train with an observation coach attached awaited us. We were whisked across the island, and arrived at Guaruja, a suburb of Santos, located across a neck of land on a famous ocean beach. Here we were delightfully surprised to find a thoroughly up-to-date hotel facing directly upon the ocean. It was fairyland, and here one could stay a month, if one had the leisure, and be content. The large rooms of the hotel, with balconies overlooking the sea, with great white waves breaking on the long sand-beach, and cool breezes fanning the tropical heat to a delicious temperature, demonstrated why Guaruja is a favorite spot for the summer sojourn of the society of São Paulo and Rio de Janeiro. Immediately in front of the hotel, half a mile out in the sea, were two cone-like mountain islands between which rolled the open Atlantic. The curved beach, a mile in length, is hard, and over it one may ride in little two-wheel, mule-drawn carts, driven by small boys who easily entice one to make the delightful experiment. Between the hotel and the beach is an unusually attractive park and behind the hotel, with broad, well paved roads, lies the little village. The houses were originally of white stucco, with red tile roofs. In the climate they have assumed many colors. Before each little home is a fenced-in garden full of green and bloom. Back of it all is a range of bald-topped, green-based hills, literally packed with the greenest jungle, and everywhere in great blotches and in satisfying blendings are flowers of many colors. But after our strenuous journey, to sit on our balcony, to hear the ocean break, to bathe in its surf, and to walk about the fairy streets, gave one a lifetime of pleasure. At evening in the west, in a notch between the black hills, as if to entice one from the sea, hung the crescent-shaped new moon, following the glow of the setting sun. The tropics was in our blood, and we could not help revelling in its beauty.

March 13. Today, after assembling for our departure, we were agreeably surprised to find ourselves booked for an automobile ride back to Santos, ten miles away. The drive was over a fine road, our machines were up to date, and our drivers were well trained. Our course at first was through a thick jungle, with a road just wide enough for the passage of one car. Above us and about us were banana trees, royal palms, and an impenetrable tangle of vines and foliage, and everywhere every color of blooming flower. At intervals little tunnels had been cut into the jungle, producing paths which led away to some hut, some telegraph pole, or some other necessary terminal. The walls of these tunnels demonstrated the impenetrability of a real tropical jungle.

We arrived at Santos, after crossing a neck of the sea on a primitive ferry drawn by a cable and accommodating four machines at a time. Our second surprise was a drive of ten miles or more on a long, curving beach, almost as hard as asphalt. In many places here on the sea-side portion of Santos, where there are stately residences and hotels, were groups of bath houses on wheels, and every convenience for surf-bathing. In the sea itself were a number of islands of different sizes, some mere rocks projecting above the water, and some the usual thumb-like hills rising high into the sky. The morning was warm with a cool breeze tempering the atmosphere. All along the shore the natives were in the surf, and everywhere, accompanied by nurse girls, were the children of the residents, wading, with their little legs bared, or splashing about in miniature bathing suits. All too soon we drove through Santos, which is a business city of about one hundred thousand inhabitants, containing many beautiful homes. Our drive of the morning took us through the suburbs—São Vincente, José Minino, Bogueirao, and Praia Grande, points of interest representing old landmarks. Later we returned for a delicious luncheon to one of the fine hotels on the Santos beach, and at 2'clock we were driven to the station to take a train for São Paulo.

3. Santos to São Paulo

The trip to São Paulo requires a little more than two hours, and will become, when known by travelers, one of the scenic pleasures of the world as it is now an engineering accomplishment. Many years ago a concession to build this railroad was granted to a foreign syndicate. The syndicate agreed to a provision which required that anything over a reasonable percentage of profit should revert to the Government. Inasmuch as this railroad is the principal outlet of the great coffee-growing district of Brazil, the profits have been enormous, and the operating company has spent as much of the surplus as possible in im-

proving the property. Besides a double-track road-bed which runs over the original right of way, a second double-track road for heavy traffic has been built, paralleling the original at a short distance. The road-bed is wonderfully constructed and the rolling stock is of the best. The engine that carried us over a portion of our route was like a beautiful Swiss watch; the metal portions were polished like silver, and the artistic beauty of its cab and boiler excited our admiration. All culverts and sluice-ways on this mountain road (and there are many such) are lined with concrete and the concrete surface is painted a glossy black. These water-ways include gutters on either side of the road-bed, and in many places they extend high above the track on the mountain side and far below into the valley. The stations, switch houses, and all equipment are most extravagant but substantial in character.

After leaving the flat country near the coast, there is a steep elevation of the road which carries it within a short distance to an altitude of several thousand feet, São Paulo being approximately three thousand feet above Santos. For the short, steep climb of a few miles, a cog road is employed, a cable traction being the form of conveyance. The coast line of hills is rapidly ascended, and the views into the valley of Santos, to the harbor below, and to the scenes that develop in the rapid climb are most thrilling. A succession of round-topped mountains with their interesting valleys are rapidly passed in review as this climb, which requires only a portion of an hour, is accomplished. On this day there was occasional rain and the mountain tops were at times covered with clouds; but the scene was fortunately not obscured by the mist. Above and below us was the deep tropical jungle with its mass of green, its trees of azaleas of glorious pink, and with a startling yellow bloom of a broom-corn nature. Everywhere spots of less vivid color heightened the effect of the green, dripping in the mist and rain. The clouds came and went and the mountains and valleys were constantly changed in light and shade. Occasionally the sun broke through the mist and threw enchantment into deep valleys or onto the mountain sides. The rain filled the water-ways and almost constantly our trestle bridges were spanning cascades that came from far above and dashed into the valleys as far below. Everywhere ribbons of water came tumbling down from some height to disappear in mist as they dashed upon the precipitate sides of the mountains. As a fitting climax to our trip, when we reached the heights the sun broke through and painted a rainbow in the valley that was far below us, and encouraged our superstitious minds to account it a good omen for our visit to Brazil.

After completing our steep climb, we coupled on real engines and sped many miles over a comfortably level country that might have been Wisconsin or Michigan, except for the occasional palm trees. In many places cattle were grazing on these plains.

II. São Paulo

1. Bird's-Eye View of São Paulo

We reached São Paulo at about 5 o'clock. In its suburbs, through several of which we passed, there was an appearance of newness that reminded us of the approaches to our own western manufacturing towns. Many of the buildings were of red brick, of modern construction with acres of glass skylights, demonstrating the rapid and recent growth of the city. São Paulo is a city of four hundred thousand inhabitants, and it is enjoying a boom growth. As we approached the old city proper it showed signs of substantial construction of long standing, having the appearance of the old cities of Spain.

We were met by automobiles, and as it was Sunday afternoon, were taken for a drive on the principal boulevards where the people promenade and drive and look upon each other on this day of rest and recreation. This gave us a most favorable impression of the residences of the wealthier people and a delightful bird's-eye view of the city in its holiday array. We then drove to our hotel, The Palace, and were prepared to enjoy our stay in this Chicago of the southern Republic.

2. Our Mission

Our object in visiting Brazil, primarily, was to meet the medical profession and interest them in the American College of Surgeons. Correspondence on our part had been undertaken as in other South American countries, but for some unaccountable reason we had not received a reply to our inquiries from our correspondent in São Paulo. My letters had been directed to Professor Arnaldo Vieira de Carvalho, the Director of the Faculty of Medicine of São Paulo and the distinguished Professor of Gynecology.

We were now settled in our hotel and as yet there were no signs to indicate that we were expected. This was particularly puzzling, inasmuch as a letter had been addressed to my correspondent not more than two weeks before. On consulting the telephone directory we found our correspondent's name and address.

However, we realized that this was the vacation season, and that there were many ways in which this silence might occur without design. So we decided to await developments.

3. *Snake Farm at Butantan*

March 14. We drove to the Government snake farm. This is located about ten miles from São Paulo, and is reached by a fine automobile road which traverses interesting suburbs. At this farm, which is really a scientific experimental station, snakes are bred and sera are made which furnish revenue to the institution. The sera are depended upon by the inhabitants of Brazil to save them from the fatal effects of bites from venomous snakes. The institution is well manned by scientists, and there is also a considerable class of students. In fenced-in enclosures there is a great variety of reptiles of all sizes, all shapes and dispositions. These enclosures are presided over by attendants who in addition to their ordinary apparel wear thick shoes, leather leggings and gauntlets, and who use as their batons sticks an inch in diameter and six feet long, with a blunt hook in the end of each. The spectator stands outside of the closely woven wire fence and looks on in perfect safety while the attendant irritates the great reptiles with the hook end of his baton, dragging them out of their beehive-like houses and tantalizing them to show fight. In one enclosure there were large trees in which the attendant would stir up some knob-like mass on a limb above him, hook up a great, struggling reptile and skillfully bring him to the earth. It is a creepy business, and by the time we left this institution nearly everybody was on the verge of delirium tremens.

In the laboratory in which the sera are made the work of the institution was demonstrated to us and we gained a notion of how familiarly the laboratory workers associate with their victims. Nearby was a pharmaceutical laboratory where quinine and other alkaloids and Brazilian drugs are prepared and tested.

4. *Dr. B. Montenegro—The Committee*

In the afternoon I was summoned to the office of the hotel to meet a caller, Dr. B. Montenegro. He proved to be a most intelligent and charming man who spoke English perfectly and who had received his medical education in the United States, having graduated from the Medical Department of the University of Pennsylvania. He is a member of the Faculty of Medicine and one of the surgeons of São Paulo, and came as the spokesman of two committees that had been appointed by the Faculty of Medicine to look after our interests, one a committee on entertainment and the other a committee of surgeons to discuss the American College of Surgeons.

Dr. Mon'enegro cleared the mystery of the one-sided correspondence. Dr. Carvalho, the former Director of the Faculty to whom I had sent my letters, had died nine months previously and my letters remained unopened and unread until a few weeks before, when they had been turned over to the Faculty of Medicine by Dr. Carvalho, a young surgeon and the son of the former Director. Then when they endeavored to ascertain the exact time of our visit they were given incorrect information. They were much chagrined to learn that we had been in São Paulo for twenty-four hours without their knowledge. The two committees included the following: J. Alves de Lima, Edmundo Xavier (Medical Director of the Faculty), Raul Briquet, Jose Ayres Netto, Moraes Barros, Antonio Candido de Camargo, Sergio Meira Filho, Lauriston Job Lane, B. Montenegro, Walther Seng, Enjolras Vampré (President of the Medical Society), Mario Gatti, Henrique Lindenberg (oto-rhino-laryngologist), Luiz de Rezende Puech (orthopedist).

A program had been prepared. At first they were anxious to have us perform several operations. This we firmly but politely declined to do, urging the soundness of the rule established by the Mayos, *viz.*, except in a great emergency, no surgeon should operate outside of the environment of his own operating room. However, we impressed upon the committee our desire to see the local surgeons at work, and to learn as much as possible of their general methods.

5. *Selecting a Professor of Gynecology*

As guests of the Faculty of Medicine we attended an unusual function that had been in process for several weeks—the selection of a professor of gynecology to succeed Dr. Carvalho, deceased. There were five contestants, all well-known surgeons and teachers. The scene that we were invited to witness occurred in a large amphitheater which opened upon a large plaza. Through the door of the ante-room we could see the audience of three hundred physicians and surgeons of the city who desired to witness the contest and await the result. The members of the Faculty, with Dr. Watkins and myself as guests, filed onto the platform at one end of the room and received an enthusiastic welcome. In the center of the arena between the audience and the Faculty, in a space about ten feet square,

were two chairs and a small table on which were a thermos jug of water and a drinking glass. The Director of the Faculty presided. From a strong-box, which was unlocked by the Secretary in the presence of the Faculty and the audience, were taken five large envelopes, each elaborately sealed. The seal of one of the envelopes was broken and a name was read. A tall, full-bearded, keen-eyed, rather pale man about forty years of age came forward and received the manuscript. He passed to the table in hushed silence, poured a glass of water, moistened his lips, and then bowed to the Director, the members of the Faculty, and the audience. In the meantime, another distinguished looking man had taken the chair at his right. Then the principal actor scanned the faces of the members of the Faculty and, remaining seated, began to read his thesis. Two weeks before, he, with the four other contestants, had been given twenty-four hours in which to prepare in his own hand-writing a thesis on the subject of pelvic peritonitis in women, the subject being announced at the time. These papers were then sealed and today each individual in turn was to read his thesis.

The first man to read was checked by one of the contestants, to guard against unfair interpolation on the part of the reader, as it was necessary that the thesis be read as it was written. The other principal tests of the contest were: A one-hour lecture before the Faculty and a public audience on some phase of gynecology, the subject being announced after the contestant mounted the platform, with the privilege of illustrating by chalk drawings, improvised as the speaker proceeded; an outline of the study, diagnosis, and operative treatment of a case, worked out under the surveillance of the committee.

Soon our speaker on this occasion was in the midst of his reading, and his entire being was engaged in the effort. He was deliberate, emphatic, and mightily impressive. He undoubtedly had some of the qualifications of an orator as he was able on several occasions to command applause, and several times laughter. But he was thoroughly in earnest, and his diction was so deliberate and direct that Dr. Watkins and I could gain a considerable notion of his argument, although we could not understand a word of his Portuguese. He finished with a dramatic, appealing climax, which brought a round of applause that lasted for several seconds. We were about ready to vote "yes" on this candidate because of the general impression we had gained from his artistic presentation.

Then the one who occupied chair number two received his manuscript, and another candidate succeeded him in the capacity of checker, and the second paper was read. This candidate was a strong, practical man, and he proceeded, apparently under considerable suppressed excitement, to read his production in an undramatic, business-like manner. At the end he was greeted by applause, but less enthusiastic than the first. As he was lost in the audience, the man who had been verifying his manuscript stepped forward and received his thesis. As he did so there was an outbreak of enthusiastic applause from the audience and some members of the Faculty. The candidate was a large, strong, clean-shaven man with an intellectual face, and a dignity and poise that augured ill for the other candidates. His thesis, which he read quietly, was enunciated with force, and his arguments were apparently sound. He commanded the attention of the entire audience, including those who did not understand his language. When he finished, there was an outbreak of applause that lasted several minutes. Many people from the audience rushed forward and offered congratulations which he received with perfect poise. The whole impression made by this man was most favorable.

The remaining theses were read by the two other candidates and the contest was finished. The meeting adjourned, and the committee (one member of which was our guide, Dr. Montenegro) retired. It was announced the next day that the third contestant, Dr. Moraes Barros, had been elected as Professor of Gynecology in the São Paulo University, to succeed Dr. Carvalho, deceased.

While driving back to our hotel, we were invited to attend, on the following evening, a meeting of the Medical Society of São Paulo, after which there was to be a meeting of the committee which was to discuss the American College of Surgeons.

6. Dr. J. Alves de Lima—Municipal Hospital

March 15. At 8:30 in the morning Dr. Montenegro took us to inspect the municipal hospital and to see some operating. This hospital is one of the teaching institutions connected with the University. The building is large and substantial, with high-ceilinged rooms and an abundance of large windows. Around it is a park-like garden filled with trees, shrubs, and flowers, and in the center is a large patio with a playing fountain. The facilities for the care of municipal patients are not sufficient. The hospital is built to accommodate five hundred patients, but at the

time of our visit it contained nine hundred. Each of the five hundred beds had an occupant and at the foot of practically every bed, in a broad aisle, was a mattress on which there was another patient.

We were introduced to many surgeons, physicians, and attendants. One of the surgeons was Dr. J. Alves de Lima. Dr. Lima strikes one immediately as a man of distinction. He is of the true Portuguese type, about forty-five years of age, and bewhiskered as are many of their distinguished men. He has the appearance of a student, tempered by a thorough knowledge of the practical world. He speaks a little English, and reads it with facility.

He was preparing to do a gastro-enterostomy for what he called an inflammatory obstruction of the pylorus. His records were elaborate, and the case had been painstakingly and conscientiously worked out. The records were translated for us, and we inspected the X-ray plates. The operating room, one of several, was large, with a skylight and sidelights, and with sterilizing rooms equipped with the latest apparatus. He operated with one assistant who aided him in handling instruments, and there was one additional attendant who handed to him sealed packages of supplies. The chloroform anæsthetic was given by a physician.

The operation was skillfully performed, with a technique that one sees in Paris where trained nurses are not available. The pathology demonstrated what appeared to be an inflammatory thickening about the seat of an old ulcer. The gastro-enterostomy was done with Mayo clamps, exactly as one has many times seen it done by the operators of the Mayo Clinic. His conduct of the case demonstrated that he is a surgeon of ability, and his technique is equal to that of the best surgeons of the world.

7. *Dr. Luiz de Rezende Puech*

We then inspected a pavilion devoted to orthopedic surgery and met its chief, Dr. Luiz de Rezende Puech. He is a genius and, like all men of that type, is an enthusiast. While knowing little of orthopedics, we were fascinated by this man who is a devoted slave to his work. As we passed through his crowded wards the patients, cripples of all forms, among them many children, fairly clung to him because of their love for him. In several places in his pavilion two children occupied one bed, and there were also many children on mattresses on the floor. This distressing condition of overcrowding is well recognized by the authorities and a definite effort is being inaugurated to remedy it. The large foundation of a new building, which will greatly increase the capacity of the hospital when its superstructure is built, was pointed out to us. However, work on this building had been temporarily abandoned because of the present high cost of production.

8. *Automobile Club—Dr. Raul Briquet*

We lunched, or "breakfasted," at the Automobile Club with a group of physicians, including Dr. Montenegro and Dr. Lima. In the afternoon we inspected the maternity hospital, a pay and charity institution which is under the direction of Dr. Raul Briquet. The hospital accommodates from 80 to 100 maternity patients, and Dr. Briquet does the operating that develops from such cases. The building occupies a site in the residence section of the city, and overlooks the city proper which lies in the valley below. The private room and ward accommodations are very attractive, and midwives and students of medicine are admitted for instruction.

9. *Dr. Watkins Appears as Orator—São Paulo Medical Society*

In advance I learned that the meeting of the São Paulo Medical Society for that evening was to be a short one, with but one paper scheduled. Therefore, I suggested to Dr. Montenegro (and the suggestion was received with enthusiasm) that Dr. Watkins be asked to show some lantern-slide illustrations of his operation for prolapse, and Dr. Watkins consented to give a short demonstration.

The society met in the assembly amphitheater of the Policlinic, which has a library and reading room, and is the gathering place for the medical profession of São Paulo. It occupies at least two upper floors of a pretentious building in the business section of the town. Dr. Watkins and I were the guests of the society. Dr. Montenegro was made the official interpreter, and to him fell the task of reading to us an address of welcome in English. To this I replied, followed by Dr. Watkins, expressing our thanks for the reception which had been accorded to us and our appreciation of their medical institutions.

The president of the society, Dr. Enjolras Vampré, honored us by making us corresponding members of the medical society of São Paulo. Dr. Watkins then presented his slides and explained briefly their purport. His efforts were received with genuine enthusiasm, and several of the gynecologists present were evidently familiar with his work. After a brief report

Alonso de Ojeda.

of a case, presented by a member of the society, adjournment was in order, and we stepped into the library, where we drank black coffee and were presented to the members of the society.

10. Organization of Committee on Credentials of the College

Later we went to the Director's room where the committee that was selected to meet us as officials of the American College of Surgeons had gathered to consider our proposition. This committee was very sympathetic to the College, and they had already decided to co-operate in every way possible. Finding them in accord with our suggestion, in the name of our Regents I asked them to organize themselves into a Committee on Credentials for São Paulo and the portion of Brazil south of them. I suggested that their committee consist of seven surgeons who were eligible for Fellowship in the College and that they elect a Chairman and a Secretary. The committee, five members of which were present, was authorized as follows: J. Alves de Lima (general surgeon), Chairman; B. Montenegro (general surgeon), Secretary; Antonio Candido de Camargo (surgeon); Sergio Meira Filho (surgeon); Henrique Lindenberg (oto-rhino-laryngologist); Luiz de Rezende Puech (orthopedist), and Moraes Barros (gynecologist). This committee promised to hold a meeting and recommend several other candidates for our consideration. The work of this night augurs well for the beginning of an enduring friendship between the surgeons of Brazil and the surgeons of North America.

11. Government Coffee Plantation, Campinas

March 16. We took a train and after a two hours' ride through the hills and valleys of the State of São Paulo visited a typical coffee district at Campinas, where we inspected a coffee plantation belonging to the Government. We lunched in a shady glen in a public park. Here in the out-of-doors, under an arch of thickest foliage, we showed our appreciation of food and drink. Dr. Montenegro, who had come with us as our guest, explained to us the method of growing and harvesting coffee. He is familiar with that industry, having been born and brought up in a coffee district two hours farther inland.

12. Banquet at the Automobile Club

In the evening, Dr. Watkins and I were the guests at a banquet given in our honor by the medical men of São Paulo at the Automobile Club. The setting was one of the most beautiful I have ever seen. The table which was laid in the banquet hall was in the form of a horse-shoe with a wealth of flowers that was bewildering.

The São Paulo Automobile Club is about the last word in clubs, being famous for its luxurious appointments, the scope of its entertaining capacity, its restaurant, libraries, card rooms, reading rooms, café, roulette rooms, and ladies' restaurant—all equipped in the most exquisite taste and without regard to expenditure.

Dr. Edmundo Xavier, a distinguished internist of Brazil who speaks a little English, presided at the feast. He is very anxious to visit the United States for the purpose of studying our medical schools and especially our method of teaching internal medicine. At the proper time, Dr. Lima read an address in English to the guests. He was followed by a young man, Dr. Paula Souza, who also read an address in English. Dr. Souza is connected with the school of hygiene which, I believe, is in some way fathered by the Rockefeller Institute. The two Americans did their best in their speeches to show their gratitude for the many courtesies which they, as strangers, had received from their new-found friends of Brazil. We North Americans can only admire, receive, and beg them to come to us so that we may bind more closely the ties of friendship.

13. Sanatorio Sta. Catharina

March 17. Visited the Sanatorio Sta. Catharina, where we witnessed an operation by Dr. Walther Seng, one of our hosts of the evening before. Dr. Seng, while a Brazilian, is a German in appearance and training. His operation consisted of an excision of the pyloric end of the stomach for an inflammatory obstruction, with closure of the duodenal end, and anastomosis of the jejunum to a portion of the stomach closure. This hospital is conducted by a congregation of German Sisters, has a capacity of 125 beds, and is open to all operators.

Later in the morning we made a short inspection of the Instituto Paulista which has three services—a surgical, a medical, and a separate department of 125 beds for mental diseases. It occupies a beautiful site, its buildings are large and its grounds commodious and beautiful. The hospitals here, like those we had visited in other cities of South America, are open to two principal criticisms by the surgeons of North America: first, the lack of adequate training schools for nurses; and, second, the lack of screens for the windows of their wards, operating rooms, and private rooms.

At 1 o'clock, after a long morning, and for the last time on this trip, we again lunched with our friends at the Automobile Club. Then we packed our trunks, and at 9 o'clock in the evening Dr. Seng called and conveyed us to the railroad station, where our train stood ready to start for Rio de Janeiro. Many of the members of the Faculty of Medicine, some of them with their wives, were there to see us off. Our compartment was filled with flowers and we were overwhelmed by the cordial, warm-hearted adieus of our delightful friends. Before leaving, Dr. Montenegro handed me the applications for Fellowship in the College of the seven members of the Committee, and informed me that they had selected thirteen others who would be recommended for Fellowship, and whose applications would be sent to me later.

III. Rio de Janeiro

1. Approach to City

March 18. The light of day came, and knowing that we were soon to descend from our three-thousand-foot altitude to the sea level through a mountainous country we were ready to take our early coffee and be transferred to a comfortable observation coach. We followed a river one hundred feet wide, and at frequent intervals dashed through small cities and hamlets that showed prosperity and resembled towns of the same size in France—except that here there is a much richer growth of foliage. At 5 o'clock in the morning a group of men were at work in a field, cultivating some crop. The midday heat seems to bring out the workers of the day in the cool hours of the early morning and at the twilight hour of the afternoon.

We began to pick our way through rugged hills along a circuitous route and were soon in a more distinctly mountainous country. The scene became more interesting and beautiful as we dropped from one fertile tropical valley into another. Later we caught occasional glimpses of the ocean with an abundance of the same dome-topped mountains that we had noted before.

Finally the five distinct finger-like mountains called the "Fingers of God" appeared, indicating that we were approaching Rio de Janeiro. The suburban towns multiplied and became more important. For long distances we ran beside stretches of beautiful roads which were lined on either side by the most decorative tree of all—the stately royal palm—until at last we found ourselves in the real city.

2. Reception Committee

In the confusion of arriving at the station, it was announced to us that a committee of doctors was there to greet us. We met and were introduced to Dr. Aloysio de Castro, Dr. José Mendonça Dr. Oscar Clark, and Dr. Olympia da Fonseca. Dr. Clark, who speaks good English, became the spokesman. They had two automobiles in which to drive us to our hotel. All members of the committee spoke a little English, but, with the exception of Dr. Clark, it was apparent that Mrs. Martin's French was more acceptable and understandable than our English.

Dr. Clark, an internist, a graduate of the University of Pennsylvania, an enthusiastic, energetic man about thirty-five years of age, apparently was to be our official host and adviser. At 4 o'clock he came with his automobile and took Dr. Watkins and me for a ride. It was a well chosen itinerary as it gave us at the outset a definite bird's-eye view of Rio de Janeiro. We skirted the sea-front boulevard and had a splendid view of the land-locked bay and harbor; of Sugar Loaf, the famous guardian island-mountain; of Corcovado, the lookout mountain; while in every direction other landmarks were pointed out, the names of which at that time meant nothing to us, but the realities of which filled us with wonder. At the end of the bay boulevard, where all seemed to end in a mountain pass, we suddenly penetrated the mountain by tunnel and came out into sunshine and beauty on the ocean front. Here was a small city of beautiful residences overlooking a half circular beach of whitest sand, where surf was rolling in in mountainous waves. Above the beach was a boulevard of asphalt with a protecting wall, and bordering that a row of palatial summer homes. One end of this beach and boulevard, carrying the unpronounceable name of Copacabana, is terminated by the mountains guarding the bay, and at the southern and eastern end by a point of land on which is an important fortification. At this farther end, the boulevard continues through an opening in the town and enters upon another boulevard that follows the ocean in another curved beach that runs almost at right angles to Copacabana and terminates two miles farther on at another mountain promontory which projects into the ocean. On this beach, called Ipanema, are located the English Country Club and some very attractive homes. To the landward side of this beach, extending almost to the boulevard that skirts it, is a beautiful fresh-water lake of three or four square miles.

Our ride on the sea-shore on this occasion ended at the mountain end of the beach, and we returned to the city by passing around the rear of the fresh-water lake and entering Rio de Janeiro through one of the mountain passes that gave us a glimpse of pretentious homes. Finally we passed the old palace which formerly housed the Emperors of Brazil and drove down a famous lane of royal palms which extends to the main approach to the palace. Our ride ended at the bay boulevard, Botafoga. We had received a wonderful impression of a city that has a hundred attractions, each one of which one is desirous of knowing in detail. Our guide was one whom we could follow with confidence and with enthusiasm.

March 19. The weather, which we expected to be extremely warm, surprised us by its coolness and its tempering by the delightful sea breeze. The temperature had not been above 80° Fahrenheit.

Dr. Bowman C. Crowell, an eminent American pathologist stationed at the Oswaldo Cruz Institute, called and during our conversation gave us valuable information about the institutions of Rio de Janeiro. At 11 o'clock I paid my respects to our Ambassador, Mr. Edwin V. Morgan.

3. *The Faculty of Medicine*

At 1 o'clock Dr. Clark came and took Dr. Watkins and me to the Faculty of Medicine. There we were met by Dr. Aloysio de Castro, the Director of the Faculty, and under his guidance thoroughly inspected the medical school plant. Dr. de Castro, a young man under forty, a neurologist by specialty, during the four years after the beginning of the European war planned and superintended the construction of this building which must be one of the most complete and comprehensive that exists. It is a large, square, two story structure of stone and stucco, having at least a six-hundred-foot frontage. Upon exploring its main entrance, one soon finds himself in a large central patio with a concrete floor. From this court, through large doorways appearing like imposing colonnades, one may enter the dozen or more complete and separate departments of the College, each with its individual equipment. The second floor is reached by a stairway which leads to a broad balcony that overlooks the court. The class-rooms are large and attractive, the ceilings are high, and each department has its own teaching amphitheater with comfortable chairs and mahogany desks for the students, and the last word in motion picture cabinets, projectoscopes, and a broad demonstration platform where every facility is provided for illustrating and demonstrating each particular subject.

The laboratories are new and are equipped with the very latest devices. Each teacher of a theoretical subject has his own separate headquarters, with a comfortable office and an exclusive apartment where he may gain seclusion.

There is an attractive assembly room for the accommodation of the students, the Faculty, and the Director. This room is used for convocations and on other important occasions. At one end of the room is a broad dais flanked at right angles by three tiers of seats, each row of seats having in front of it a large continuous desk. This slightly elevated platform is for the seating of the Director, the Faculty, and other distinguished personages. Its general contour is like a horse-shoe whose ends open into a broad room where the audience is seated and which in turn opens through a colonnade onto the central patio of the whole building.

The medical school occupies a beautiful site under the brow of a mountain at the extreme southern end of the bay. It faces the bay, reserving on its side next the water, and under the shadow of Sugar Loaf, a splendid location for the contemplated and much needed clinical hospital. There is a sufficient reserved space to the south of the main building to accommodate an anatomical building and leave plenty of room for future expansion.

Through the great open windows of one of the recitation rooms, with its polished mahogany seats and attractive equipment, we could see the mountains and the shipping of the bay. One of us remarked to the Director that he must have had an eye to the artistic environment in the construction of his workhouse. "Yes," he explained, "one can do more inspiring and more interesting teaching if his surroundings are attractive and satisfying."

Returning to the hotel we met Dr. Mendonça who called with his wife and daughters, accompanied by Dr. Clark, his son-in-law. Dr. Mendonça is practically the Dean of Surgery in Rio de Janeiro, having had a long and distinguished career. He and Dr. Clark went over with me for the first time the list of the surgeons of Rio de Janeiro, and informed me that a committee of five surgeons had been appointed by the Director of the Faculty, Dr. de Castro, to act as my advisers in regard to the American College of Surgeons. Then, that we might be prepared to enjoy the city to our full, they took us to wit-

ness a motion picture film that had been taken from an aeroplane. It was a wonderful production, and under the guidance of our friends we received an impression of beautiful Rio de Janeiro that we could never have gotten in any other way.

As we sat on the roof garden of our hotel that evening in a flood of moonlight, with a delightful summer temperature, with the city lights all around us, it began to dawn upon us that the extravagant things that we had heard about this southern paradise were attempts to describe the indescribable.

4. The Bay

March 20. In a comfortable steam launch we made a trip on the bay, out by Sugar Loaf to the south, east to the entrance to the harbor, and along the sentinel islands that separate the Atlantic Ocean from the bay. We traversed the shore line to the north until nearly the entire bay had been circumnavigated. From our launch we could get a perspective of the city with its irregular water line, its docks, its projections and indentations, its mountain background, its hills, and its characteristic buildings of many colors. It rained during a part of our excursion, but that only emphasized the greenness of the foliage which is so rich everywhere, and added to the mystery of the many valleys and coves. [We returned to the city at 3 o'clock. It was Palm Sunday, and in all of our lives we had never known a day that was better named.

5. Oswaldo Cruz Institute

March 21. The equinox. Rain in a downpour from early morning until 9 o'clock in the evening. As yet we had not experienced any very warm weather. In the early morning, Dr. Crowell of the Oswaldo Cruz Institute, and Dr. Clark called and carried us off to inspect the Institute, named for their Gorgas—Dr. Oswaldo Cruz. We drove in two cars to the north end of the city where on an elevation near the sea is the principal structure of this institution, the experimental laboratory, a very ornate building four stories in height and of Moorish construction. The Institute was founded in 1899 by Oswaldo Cruz, who was the pioneer in cleaning up Rio de Janeiro and later other outlying portions of Brazil. He eradicated yellow fever and the plague by following the principles which had been put into practice by our own Gorgas in Cuba and Panama. The President of the Brazilian Republic, who was skeptical concerning Cruz' ability to carry out his promise to eradicate yellow fever from Rio de Janeiro in one year, said to him: "How can I be sure, after all the expenditure of money that will be necessary, that you will be successful in accomplishing this miraculous feat?" The enthusiastic scientist replied: "If I do not succeed, you may behead me." Within the year yellow fever was stamped out, and from that time to this Rio de Janeiro has been one of the most wholesome cities in the world. Oswaldo Cruz, who died several years ago at the age of forty-four, is a national hero. One of the most attractive boulevards of the city is the Avenida Oswaldo Cruz, and in many places may be seen portraits and busts commemorating him.

The Institute which now bears his name was planned and built by him, the Government contributing toward its construction and maintenance. The Government now appropriates one-third of the expense of its up-keep. Thirty medical men, pathologists, curators, and other scientists are engaged in the work of the Institute. It is a great experimental center for study and teaching in connection with tropical diseases. At the head of it at present is the distinguished Dr. Carlos Chagas, the discoverer of the tropical disease popularly known as the Chagas disease. Dr. Chagas, while in the interior studying malaria, noticed an incurable disease which was characterized by enlarged glands, anæmia, and final death. As it did not come under the head of malaria he decided that it was caused by some form of blood infection and probably from some parasite imparted by the bite of an insect. Finally, by untiring observation, he discovered that the disease was caused by the bite of a beetle-like bug which thrives in hot, unhygienic surroundings where people sleep, and which pursues its work in the early hours of the morning. It deposits a parasite or organism which Chagas has isolated and demonstrated to be the cause of the disease. The individual having the disease shows the parasite in his blood, saliva, and tissues.

We were shown through the Institute in a preliminary way by Dr. Crowell. On the arrival of Dr. Chagas, he took us in charge. He is a man of medium size, with a fine, long head, and dark complexion, who at once, from his frank, direct manner, ingratiates himself into one's being as a friend. He is about to visit the United States as the guest of the Rockefeller Institute.

Another interesting head of a department of the Institute is Dr. Adolph Lutz, who is in charge of the work of preparing prophylactic and curative sera. His daughter, an attractive girl who speaks our language, is his assistant. Dr.

Dr. Oswaldo Cruz (deceased), Founder of the Oswaldo Cruz Institute, Rio de Janeiro, Brazil.

Dr. Carlos Chagas, Director of the Oswaldo Cruz Institute, Rio de Janeiro, Brazil.

Lutz is a serious-faced, apparently overworked man, an enthusiastic scientist, devoted to his work, and who, I suspected, thought: "What do all of these ignoramuses know about this intricate subject?" However, I want him to know that we were much impressed by his strong personality and his very interesting exhibit.

The day was a red letter day for us and furnished one more thing to make us humble. How proud we all would be if such an Institute as this could be built as the first experimental unit of an international school in Panama for the study and teaching of tropical diseases, liberally constructed and endowed, and known as the Gorgas School of Tropical Medicine!

After leaving the Institute, Dr. Clark drove us back to the city, and, incidentally, made a detour that gave us for the first time a view of the elaborate docking facilities that the Government has constructed in improving its harbor. The docks are modern, with elaborate machinery for loading and unloading and great storage warehouses flanked by a broad, well-paved drive or approach that will extend for miles along the coast.

We then drove to the American Embassy where I had an appointment with Mr. Morgan, our Ambassador. He invited us, with our wives, to luncheon with him at his summer residence in Petropolis at which time he was endeavoring to arrange for me an audience with the President of Brazil, who also has his summer palace in Petropolis. I found Mr. Morgan sympathetic to the Gorgas memorial plan, as he, like all Brazilian residents, had seen a practical demonstration of the application of the principles employed by Gorgas in stamping out tropical diseases.

March 22. Day of rest. Took long beach drive with the ladies. Temperature remains delightful—today about 75° Fahrenheit. In fact, in this first week we have had none of the oppressive heat that we experience in our northern summers.

6. *Sugar Loaf Mountain (Pão d'Assucar)*

March 23. Took automobiles to the entrance gate for Sugar Loaf, a conical-shaped mountain which towers over the bay. The trip to its summit is made in two stages, from the base to

a companion mountain, about two-thirds the height of Sugar Loaf, called Penedo da Urca, where we disembark, traverse the top of this way-station, and take the long, final trip to the top of the mountain. The vehicle of transportation is a small basket-like car, accommodating twenty passengers, which is suspended in midair on hung cables, and on them carried from one mountain height to the other. Viewed from a distance this aerial flight appears as a very perilous undertaking; but the reality furnishes a novel but unterrifying experience. When we reached our first station, we were concerned to see the higher second peak covered by a cloud. As we proceeded, however, it disappeared, and we were rewarded by a sunlit view of the bay, the city, the amphitheater-like mountains back of the city, and the great ocean to the east and south. A view from above of the tropical jungle that lies between the two mountains is a most interesting sight. It has a beauty of color, and a feathery-like softness of appearance that fairly tempts one to jump into it.

In the evening our courteous friend, Dr. Clark, took us with our wives for a drive. He pursued, at the beginning, the same route that we had taken on the day of our arrival—the shore boulevard, through the tunnel to Copacabana, with its circular beach, through the beach at Ipanema, past the Country Club, to the terminus on the south at the mountain-like promontory projecting into the sea. Here we found that this wonderful boulevard continues for many miles on the sides of the cliffs bordering the ocean. This road is lighted by electricity and is a great engineering accomplishment. Presently the real object of our ride was revealed. We were asked to look back from the heights. There below us were the two wonderful beaches, stretching for miles, with the white foam of the surf gleaming on the broad stretch of sand. The skirting boulevard was made conspicuous by the great string of electric lights, which transformed the whole scene into fairyland, and gave to it the appearance of necklaces of gold and jewels. We feasted upon this ever-changing scene as we retraced our mountain road and wondered if we had ever before seen anything so beautiful.

7. Corcovado—Paineiras—the Aqueduct

March 24. This day we visited Corcovado. The mountain is reached by cog railroad and has on its peak a pavilion which overlooks the city and surroundings. From this vantage point one gets not only a superb bird's-eye view of the bay of Rio de Janeiro and of the city itself, but of its relation to the surrounding country, its several summer suburbs with their extensive ocean beaches, and also of the mountain landmarks among which this is one of the most conspicuous. On arriving at the summit this day, we were enveloped in a dense cloud. Our disappointment was reaching the point of despair, when slowly, as through the screen of the cinematograph away below us we discerned in the brilliant sunlight the ocean beaches of Copacabana and Ipanema. Turning we had a faint view of the city proper and its bay and shipping. Then a cloud enveloped us and the view disappeared. This was repeated several times, and finally the view was shut out not to be again revealed.

The ride down the mountain side through its tunnel of green jungle, with the many glimpses one received of the valleys below, was as pleasing as the complete view received from the height on a clear day. Nowhere about Rio de Janeiro can one view the jungle to as good advantage as on this ride. Here are depths and heights and the impenetrable tropical tangle undisturbed. Here are the purple and the yellow trees, the masses of vines and shrubs, the songs of birds, the high note of the many insects, and often against the green of the mountain the wonderful butterflies.

Part way down the mountain we emerged into the sunlight with clouds and shadows of clouds around us, and stopped at Paineiras, a halting place, where a station and a restaurant mark the route of an ancient aqueduct that was built three hundred years ago to furnish water for Rio de Janeiro. The aqueduct is constructed of solid masonry and now, after three hundred years, is in perfect repair with a stream of pure mountain water flowing swiftly in the trough at its top. Paralleling the duct is a level path that one can follow for miles along the mountain side. It is buried under an arch of green, but at intervals openings between the foliage enable the pedestrian following its meanderings to get charming glimpses of the valley below. Many times in the seclusion of this place highly colored paroquets and sporting monkeys appear, although we were not fortunate enough on this occasion to see these signs of the real jungle. However, one cannot walk by this ancient work in the cool shade and listen to the song of its running water without being fascinated with it all. In this place, and in the mood of the tropical jungle, we lunched and satisfied the hunger of the body.

8. Santa Thereza Hill—San Silvestre

March 25. Passed a quiet day that was utilized in a ride by tram to the International Hotel, located on Santa Thereza Hill, and on to San Silvestre, a terminal on the Corcovado road. The tram takes one along the route of the old aqueduct which in many places at this height has been destroyed to furnish material for the construction of the road. On the approach to this hill and on its terraces are many of the picturesque homes of the people of Rio de Janeiro. Here, hundreds of feet above the bay, they have beautiful views, a stirring cool air, and the silence of the country.

9. Policlinic

March 26. Visited the Policlinic with Dr. Clark. It, too, was organized and is directed by Dr. Aloysio de Castro. This clinic is for the poor and deserving and is supported by the municipality. It is a substantial, four story building located on the Avenida Rio Branco, in the center of the fashionable shopping district of Rio de Janeiro, and all but the lower store front is occupied by the clinic, its laboratory, pharmacy, operating rooms, X-ray rooms, and administration rooms. It is an artistic structure and like all public buildings in Rio de Janeiro, it was built for all time of stone, steel, and marble. Its furnishings are substantial and its administrative offices and lecture rooms are elegant. The land and the building were given by the Government, and the clinic is maintained by an annual appropriation from the Government.

All medical cases are treated here, and minor surgical operations that can be performed without hospital accommodations. Students from the University receive instruction in the clinic, the attendants being teachers on the Faculty of Medicine. So far as I could learn, there seems to be no special provision for the teaching of graduates in medicine.

10. The Alleluia

In the afternoon we explored the city, which is an ever continuous source of pleasure, and in the evening were the victims of a ball at our hotel celebrating the Alleluia. This is an annual event of importance on the eve of Easter Sunday at which time the populace gives vent to rejoicing at the end of Lent. The ball afforded us an opportunity to watch the smart set of the society of Rio de Janeiro, aided by adventurous strangers from all the world, disport themselves in gala array and festive mood. There were many lights, much music, much dining and dancing on the out-of-door roof garden, lasting until the small hours of the morning. Through the eyes of our American young people, the Brazilian style of dancing appeared rather strenuous; but it was evident that the example of numbers prevailed, and before morning they had become apt imitators in the acrobatic struggle.

March 27. Easter Sunday. Clear and cool. Mrs. Martin and I attended the Catholic Cathedral where mass was being said by the Cardinal. The service was most impressive and interesting.

At 5 o'clock Dr. Clark drove us to the home of his father-in-law, where he himself lives, to take tea. The home is on the Santa Thereza Hill and has a most extensive view. We received a most cordial greeting and met several of their Brazilian friends, including Dr. de Castro and Dr. da Fonseca with their wives, Señora Mendonça and her two daughters, the Señora Clark and Señorita Mendonça, also Señorita Solsa. There was some conversation in French, Portuguese, Spanish and English, and good music. Señorita Mendonça played the violin with the skill of a professional. Dr. de Castro asked me if I was fond of music, and upon replying in the affirmative he asked me if I sang or played some instrument. Of course, I had to admit that I had no technical knowledge of music; but in turn I asked him if he was a practical musician. He admitted that he was passionately fond of music, played the piano for his own gratification, but was shy about performing before others. Finally he was prevailed upon to play. This Director of the Faculty of Medicine, a distinguished professor of neurology, modestly proceeded to the piano and with great skill and delicacy of touch played several delightful numbers, including a well-known Chopin Prelude, and excited the envy and admiration of his American auditors.

We inspected Dr. Mendonça's extensive library of medical and general literature in Portuguese, French, English, and German, all languages which he reads. We drank tea and enjoyed the delightful hospitality of a Brazilian home.

11. Tijuca

March 28. Tijuca! a name that excites the memory and the imagination of every visitor to Rio de Janeiro. While it is the name of a mountain, it calls to mind a marvellous circular drive through Alta Bõa Vista, Vista Chineza, Meza de Imperador, Gavea Mountain, the sea cliff road, Leblon, and a return trip by the famous beach boulevards through Leme, Copacabana and Ipanema. At 9 o'clock on a beautiful morning like one of our own in June, we started in comfortable motors with reliable guides and chauf-

feurs to take this drive. No description can do justice to this excursion. In it are packed all of the thrills and panoramas of Rio de Janeiro, a marvel of mountain sides, impassable heights, impenetrable jungles, fascinating bridle paths, and astonishing water falls which seem to come from the very skies, cascades, and bridal veils of mists.

At one point high on the mountain we emerged upon a promontory, and there below us was the many-colored city of Rio de Janeiro, the great harbor, and in a small gap between two island hills the Atlantic Ocean stretching on to Africa. In the great unfrequented valley below was a riot of color in the feathery green depths, and to the right and left near us towered impassable rugged peaks of mountains. At another window in this highway we saw far below the ocean beaches of Copacabana, Ipanema, and Leblon. They are like wonderfully executed maps; the outlines are so pleasing and symmetrical and the coloring is so unobtrusive and satisfying. For miles we continued to and fro, up and down, and around sharp turns, and all of the time we marvelled at the engineering feat that wrought this roadway which we enjoyed with perfect security.

Finally, at the bottom of a valley that has the appearance of "Hell's Half Acre" because of the confusion of monster boulders that have been thrown there in some remote convulsion of nature in the beginning of things, and that have been clothed in their nakedness by the green mantle of the tropics, we stopped under one of these boulders, propped up by several others, and spread and ate our luncheon. Near by was a rushing brook of clear water that reminded us of the trout streams of northern Wisconsin.

Then we motored home over the cliff road by the side of the Atlantic under the brow of Gavea, and by the Country Club where some of us stopped for a plunge in the tank or a frolic in the surf. It was an excursion that left one confused by its many revelations and anxious to spend a lifetime in admiring it in detail.

12. Organizing a Committee on Credentials

March 29. Attended a meeting at the Jockey Club of the committee appointed by the Director of the Faculty of Medicine, Dr. de Castro, to consider affiliation with the American College of Surgeons. Those present, besides Dr. de Castro and Dr. Clark (both of whom are medical men, the latter being present to act as interpreter), were Dr. José Mendonça, Dr. Alvaro Ramos, Dr. João Marinho, Dr. Auguste Paulino de Souza, and Dr. José Antonio de Alvan Fialho. After some preliminaries, I explained in detail the purposes of the College of Surgeons and the reasons for our desire to affiliate with the surgeons of Brazil, adding that if our wishes met with their approval, it was our desire that they proceed to organize a Committee on Credentials for the central and northern portion of Brazil, this committee to consist of seven members: surgeons, gynecologists, obstetricians, ophthalmologists, and aurists. I had furnished each member of this preliminary committee with a typewritten copy of the outline of the talk that I expected to make. As they all read English, this prepared them to follow me more intelligently and to be prepared to act. The advances of the College as presented by me were cordially received. They promised to meet and to enlarge this committee to seven, to elect a Chairman and a Secretary, and to bring to me the applications for Fellowship in the College of the members of the committee. The committee also would carefully select an additional group of about fifteen Rio de Janeiro surgeons whom they would recommend for Charter Membership. I also asked them to suggest the names of a few surgeons from Bahia and Pernambuco. The meeting adjourned for coffee after we had accomplished a very satisfactory hour's work under the Chairmanship of Dr. de Castro, and with Dr. Clark as our interpreter.

13. A Surgeon's Office—Dr. José Mendonça

March 30. Visited a model medical and surgical office. It was the private workshop of Dr. Mendonça, the surgeon, and Dr. Clark, the internist. The building, a four-story structure with a pharmacy on the first floor, was constructed on one of the principal business streets for the exclusive use of Dr. Mendonça. It contains an elevator and every convenience and modern apparatus for which an up-to-date surgeon and physician could wish, including an X-ray apparatus, a laboratory, and complete record files.

Early in the morning Dr. Crowell called and I had a long talk with him about the proposed Gorgas Memorial which I hope will take the form of an experimental school in tropical medicine, something along the lines of the Oswaldo Cruz Institute in which Dr. Crowell is the advisor in pathology. Dr. Crowell has spent several years in the Philippines studying tropical diseases. He speaks Spanish, and during the short time he has been in Rio de Janeiro he has become very proficient in Portuguese. He is much interested in our scheme, and has promised to give me his views on the entire proposition.

14. Sugar Loaf (Pão d'Assucar) at Twilight

March 31. Visited Sugar Loaf (Pão d'Assucar) at twilight to see the sunset and the lighting of the city and bay. The sun sank in the west behind a curtain of mountains and a bank of clouds and sent a parting glory of yellow and red high into the heavens. All about us were the city, the bay, the mountains, the beaches, and to the east the Ocean. The colors rapidly disappeared in the tropical twilight, and, indistinctly at first, appeared the lights of the city. Then rows on rows of lights, like ropes of diamonds, were flashed on, and the picture was a map outlined in gold. Ships sent out their beacons, and far away at sea light-houses flashed their signals to the night traveler on the deep. And everywhere the picture was duplicated in the waters. We quietly watched these changes, wrought by man, and the eternal lights that dotted the heavens above us.

15. Opening of the Faculty of Medicine

April 1. At 1 o'clock Dr. Watkins, Mrs. Martin and I went to the Faculty of Medicine to attend the opening of the school for the year. Dr. Watkins and I had been invited as honored guests, and we had been notified that we would be expected to respond to an address. We were met at the entrance to the building by Dr. de Castro, the Director of the Faculty, and conducted to his room. There we met the Director of the University, a number of the members of the Faculty, and a Dr. Solomon of Vienna, who was also being honored as a distinguished guest. Señora de Castro, Frau Solomon, Mrs. Crowell and Mrs. Martin were the ladies present.

Presently we filed into the large assembly room of the School, and the Faculty and guests were distributed in the seats of the raised dais facing the arena which stretched away to the patio through the open colonnades. The hall was filled with students who gave us a vigorous reception in handclapping and "Oh! Oh's!" as we found our places. The three distinguished guests were seated in front of large desks at the right of the presiding officer, Dr. de Castro, he in turn sitting at the right of the Director of the University. The ladies sat opposite on the left wing of the horse-shoe of raised seats. Sitting, Dr. de Castro explained the occasion that had brought us together, and in the course of his remarks our names were repeatedly mentioned. At the end of his remarks, which were applauded at intervals, Dr. Fernando Vaz, a member of the Faculty, arose, and read an address in English directed to the two American guests. At its conclusion we each responded in turn, and of course in English.

Dr. José Mendonça, Surgeon of the Faculty of Medicine, Rio de Janeiro, Brazil.

My remarks, while made extemporaneously, were along the same general lines as those made by Dr. Watkins. However, I referred to the visit of Dr. Mayo and myself of the year before and to my return visit with Dr. Watkins as follows:

"One year ago, with Doctor Mayo, I was privileged to visit the neighboring countries of South America—Peru, Chile, Argentine, and Uruguay. Again this year, with my colleague, Doctor Watkins, I have visited these same countries, and have been greatly gratified to visit also two great medical centers of Brazil—the largest country in South America.

"In the neighboring countries and in your country we have found medical schools which equal in equipment, in teaching methods and in clinical facilities, those of the United States and Canada, and, what is of more importance, a compulsory course in medicine or from six to seven years instead of the four and five year course required by the countries constituting the balance of the world.

"Here, in the most beautiful city of the world, we have inspected, under the guidance of your

honored Director, your new and perfectly equipped medical institution, which now, today, we are so proud to occupy. When I return to you next year I predict that on the beautiful plot of ground across the Avenue there will appear the foundation of a great clinical hospital, and on another a great anatomical building which will be constructed, equipped, and financed by your very efficient Government. With this, your palace workshop, and with that, your clinical hospital, and with your many hospitals that already furnish you with adequate clinical material, and your great Oswaldo Cruz Institute for the study of tropical diseases, with its distinguished Doctor Chagas, the medical students of Brazil are most fortunate.

"Do you appreciate the responsibility devolving upon the medical profession of Brazil? Do you realize that the Panama Canal could not have been built if it had not been for Gorgas and his sanitarians? Do you realize what a garden spot of the world Brazil will become if for the whole country the same work is done that has been done here in Rio de Janeiro by Oswaldo Cruz, Carlos Chagas, and your group of brilliant sanitarians?

"I extend my congratulations to the students of this university. I congratulate you, the members of the Faculty, in having about you such wonderful facilities for doing your work, for such a distinguished body of students. And I congratulate you, our Director, for the magnificent work that you have performed for the science of medicine in this great country, and for the loyal Faculty and student body that you have collected about you to support you and to encourage you.

"And now, before closing, let me extend a sincere invitation to you all,—students, Faculty, and Director—to visit our United States of North America, and in doing this I wish to present the greetings of the medical profession of my country to the medical profession of the United States of South America—*Brazil*."

Two amusing incidents occurred while we were speaking. During Dr. Watkins' talk, without warning to him, the newspaper photographers exploded a flash-light which went off with a terrific report. Perceptibly he jumped; but the flow of oratory possessed momentum that would not be brooked and it went on. The sound of my strange voice and unknown tongue aroused the well cultivated voice of some mongrel dog that had wandered into the meeting room, and for fully a minute it vied with me, and at one time I thought that the cur was going to win in the contest; but I struck a higher pitch and succeeded in discouraging him in his efforts. Each of us of course received vigorous applause at the end of our talks. It was inspiring to watch the audience of students. As soon as the members of the Faculty were seated the students left their chairs and crowded forward and stood, completely filling the arena in front of the Faculty group. They were a fine, brilliant lot of young men, and they seemed to be keenly interested in the speeches made in an unknown tongue by the guests.

Dr. Marinho made an address in German to Dr. Solomon and he responded at considerable length in French. After a few other formalities we went to an upper room in the building and were served with coffee, ices, and *patisserie*, drank several toasts and then, with the Faculty and the ladies, were duly photographed.

We later drove to our hotel, relieved ourselves of our long-tailed coats and silk hats, and at 4 o'clock were taken by Dr. de Castro and Dr. Clark for another ride to the wonderful Tijuca. The day was perfect, the afternoon sun making more beautiful the winding roads and bridle paths in the mountain valleys. One can never tire or solve the mysteries of this excursion in the hills. It was particularly delightful to have these new friends as guides and to have them point out the beauties which appealed to them. It is like life, this exploration of these intricate natural beauties, one receives from it according to his tastes, his standpoint, and his ability to appreciate.

16. Petropolis

April 2. Petropolis. The evening before we had received a telephone message from Mr. Morgan, our American Ambassador, stating that he had arranged an audience for me with the President of Brazil, and inviting me, with Dr. Watkins and the ladies, to luncheon with him at the Embassy in Petropolis; afterwards he would accompany me in my visit to the Executive Mansion. Petropolis is a city of summer homes for the society of Rio de Janeiro and the Government officials, including the official home of the President. It is also the site of the summer homes of the various ambassadors to Brazil. It is situated in the mountains, at an altitude of several thousand feet, about two hours out of Rio de Janeiro, and is reached by railroad. For a part of the way the steep climb is made by cog road. The scenery along the way is most interesting and would become worldfamed if it had not to compete with the environment of Rio de Janeiro.

Faculty of Medicine, Rio de Janeiro, Brazil.

On arriving at Petropolis we took a drive about the interesting city. It is peculiar in that it has wide streets through the center of which, dividing them into two roadways, runs an open canal thirty to forty feet in width, through which flows pure water from the mountains. These canals are bridged at the street intersections and are bordered with trees.

At 12:30 we arrived at the Ambassador's residence, and were cordially greeted. Mr. Morgan, a charming bachelor about forty-three years of age, has been the Ambassador to Brazil for nine years, having been appointed during ex-President Taft's administration. He is very popular with the Brazilians and they are extremely anxious that he shall remain with them. He seems equally fond of them having learned their language and become one of them. Mrs. Benton, the mother of a Secretary at the Embassy, was hostess this day, and we had an interesting and delightful luncheon.

At 2 o'clock the Ambassador accompanied me to the "White House," which is located in the grounds adjoining Mr. Morgan's attractive residence. The Secretary to the President, Señor Estamphila Demoura, is a Brazilian Naval Officer who during the war was a naval attaché in the Brazilian Embassy at Washington. While in Washington he lived at the Highlands, and knew, admired and loved General Gorgas, who was his neighbor. As my object in visiting the President was to interest him in a proposed memorial to General Gorgas, I considered that it presaged well for my mission to have the sympathy of this influential attaché who is so near to the Executive.

Mr. Morgan accompanied me when the President received me. The President rose from his chair which was next to a table at the end of a long room that might have been the cabinet room, greeted us cordially, and conducted us to chairs. He is a man of medium height, bronzed skin, keen, brilliant eyes, dark, bushy hair, and an agreeable and attractive personality. He speaks English fluently. I related my story about the Gorgas memorial, and fortunately was able to illustrate the value of the memorial that I proposed by the example of the Oswaldo Cruz Institute which is supported by his own Government, and by the work that the Institute is doing under the directorship of Dr. Chagas. I also took the occasion to congratulate him on his sympathetic support of their Medical School, and to call his attention to the great need of the school for a clinical hospital. He asked a number of questions, showing a genuine interest in my mission, and was apparently much pleased by my appreciation of their medical institutions.

As we were leaving, he called the Ambassador to him and told him, with apparent elation, that he had just received from President Wilson, a personal letter in his own handwriting, thanking him for some expressions of appreciation in regard to Mr. Wilson and his great work that he had uttered in an interview. President Epitacio Pessao was the Brazilian representative at the Peace Conference in Paris, and had known President Wilson there.

We then returned to the Ambassador's home, spent a half hour in the beautiful grounds, taking some snap-shots as souvenirs, and making our adieus after a very happy and delightful day.

April 3. Dr. Alvaro Ramos called and invited us to a clinic for Monday. He informed me that the tentative committee on the affairs of the American College of Surgeons had met, added two to its number, and as a full-fledged Committee on Credentials, had elected Dr. José Mendonça as Chairman, and Dr. Olympia da Fonseca as Secretary. As Dr. Fonseca has been for many years the Secretary of the Society of Medicine of Rio de Janeiro, we felt that an experienced man had been chosen. The day was warm and we kept well within doors and enjoyed a Sunday rest.

In the evening we were the guests of Dr. Bowman C. Crowell at the Hotel Central. The Swedish Minister, Mr. Herman Gade, and his charming wife, a Chicago woman, were also guests. It was a delightful treat to limber up our Yankee tongues and be sure that we were being understood. We adjourned to the roof garden for coffee, and had another view of the electric-lighted bay and city. But a short distance away was Sugar Loaf, with its stations illuminated and its little basket of human cargo swinging to and fro.

17. A Surgical Clinic

April 4. Visited the Misericordia Hospital, the large municipal institution with several hundred beds, and witnessed an operation by Dr. Alvaro Ramos. The case had been well worked up and the records were read and translated to us. The diagnosis was a "retroperitoneal cyst of the middle abdomen." The written records shown to us in this hospital would have warmed the heart of the Committee on Hospital Standardization of the American College of Surgeons. Ether anæsthetic was administered. The cyst was exposed and rolled out, and proved to be a tumor of the mesentery. It was skillfully handled and we could not but be pleased with the correctness of the diagnosis. Dr. Ramos is a skillful surgeon. His technique is that of the French, and of the character that one would approve for an operation upon himself. These are skillful, daring operators. Dr. Ramos showed us his wards, large airy rooms, the laboratories, and the large out-door dispensary containing hundreds of waiting patients.

18. Strangers Hospital

We than drove with Dr. Ramos and Dr. Franklin P. Pyles (an American surgeon) to the Strangers Hospital, the English Hospital, built in an attractive location on a hill overlooking Botafoga Bay. With Dr. Ramos we also inspected a large insane hospital in which he has a surgical service. We then visited his home, a commodious residence on a fashionable street, where we viewed his extensive library. Three large rooms, filled to the ceilings, were required to accommodate the books and pamphlets. Dr. Ramos is proud of this library, and he may well be. He had English, German, French, Spanish, Italian, and Portuguese journals and text books, all of which he reads. I was gratified to see that SURGERY, GYNECOLOGY AND OBSTETRICS, in files from the beginning, occupied several shelves, and that he had taken the INTERNATIONAL ABSTRACT from the journal proper and had bound them in separate volumes. He took pains to show us a number of copies of the *Journal of the American Medical Association* which contained the articles on South America written by Dr. Nicholas Senn fifteen years ago.

19. Luncheon with Dr. Chagas

At 12 o'clock Dr. Watkins and I with our wives were guests at luncheon at the home of Dr. Chagas. This gave us another opportunity of visiting a Brazilian home. Dr. Chagas, who speaks some English, and his charming wife, who speaks more English, and an attractive son of seventeen who outstripped them all, were our hosts. Dr. and Mrs. Crowell and one other couple were also guests. We had a delightful hour, and we are looking forward to the visit that Dr. Chagas and his family are about to make to the United States. This scientist has a charm of manner that is irresistible, and an expression of adequacy and extreme modesty.

20. An Emergency Operation

On one of the early days of our visit to Rio de Janeiro Dr. Clark called for us in the edge of the evening to see an emergency appendectomy which Dr. Mendonça was to perform on one of his students. He was to operate in a strange hospital. Everything was new to him, and besides Dr. Clark, who was acting as first assistant and who was giving the ether anæsthetic, he had but one assistant in the operating room.

The case was a difficult one, with a retrocæcal gangrenous appendix. The operation was carefully and skillfully performed. We were grateful to this great surgeon for calling us to see an emergency operation that was to be performed in a strange environment—which always takes courage and shows that the operator has the courage of his convictions.

April 5. Visited a well equipped hospital which had been the residence of a wealthy citizen, and which was located in an extensive private garden. It is exclusively for maternity cases and attendant ills. We were met by Dr. de Castro, the Director of the Faculty. We saw an abdominal section for a retroversion, and a Gilliam operation, skillfully performed. The operating technique was conventional and good.

We then drove to another Maternity Hospital, where we saw Dr. Magalhães, a handsome man with the face and appearance of our own Marion Sims in his younger days. He showed us his hospital and we saw him do a good operation on an ovarian cyst. There has been an attempt to screen this hospital under the inspiration of a South American who recently visited North America, but it has been a failure because instead of placing a large screen on the outside of the large window casing in a position not to interfere with the opening inward of the French windows, the screens had been placed in one or two of the window lights of the French windows, leaving the glass panes in the others. To make the screens effective, the windows must remain closed and the air is excluded. If the windows are opened, as they should be most of the time, the screens are of no use. It was evident, of course, that the screens were not a success and had failed in practice to popularize themselves.

21. *The American Chamber of Commerce*

At noon we were guests at the Restaurant Assyrio of the American Chamber of Commerce of Rio de Janeiro. This luncheon was given in honor of the members of the American Express Company's party. About two hundred men were in attendance and it was an attractive function. Dr. Watkins was one of the speakers.

In the evening Dr. Watkins and I were guests at a banquet given at the Hotel Central by a group of the medical men of Rio de Janeiro. Among the Rio de Janeiro medical men present were Drs. de Castro, Chagas, Mendonça, Ramos, Couto, Vaz, Clark, Fonseca, Leas, Marinho and others. Dr. Mendonça presided at the social function which followed the banquet and read an address to the guests. The banquet was given as a courtesy to the representatives of the American College of Surgeons. I responded in behalf of the College and thanked the profession of Rio de Janeiro for the cordial reception they had given us. I explained the reason of the visit of Dr. Mayo and myself last year, and of the return visit of Dr. Watkins and myself this year, and, in behalf of the College, invited the surgeons of Brazil to visit the Clinical Congress of the College to be held in Philadelphia this year. I spoke particularly of the broad culture of the South American surgeons and our realization that the medical men of South America were not satisfied with their own immediate environment alone and were not content to remain provincial, but that they insist upon taking supplementary courses of graduate instruction in England, France, or Germany; that this presupposes the knowledge on the part of the South American doctor of at least one language besides his own, and frequently of two or three foreign languages; that the South American surgeon is, therefore, a world's man, a cultured man, and not of the too commercial type; that we found the members of his family to be linguists; that they have travelled, and that they are highly cultured; that the average South American surgeon—in his knowledge of the world, and in his professional information—is probably far in advance of the average of his professional brethren in the United States and Canada; that Dr. Mayo and I had found in South America some of the best hospitals in the world; that we had observed some of their surgeons at their work, and had admired it, and that we hoped all of this would cement a closer relationship between the surgeons of the two Americas; that our problems are different, and only by a friendly interchange of opinion can we view things from the same standpoint; that many of our surgeons of North America are desirous of visiting South America and of learning from the surgeons of the southern continent; and, in turn, that we wish to have the surgeons of South America visit the United States and Canada.

I closed my remarks by congratulating the surgeons of Rio de Janeiro, the metropolis and capital city of Brazil, in establishing but one medical school. I urged them as men in authority to combine in their Faculty of Medicine all of the strong men in order to prevent the development of factional groups, which would scatter the efforts of the profession by fruitless competition.

April 6. Witnessed an operation by Dr. Pyles, a capable American Surgeon, at the Strangers Hospital.

22. *A Nose and Throat Specialist—Dr. João Marinho*

April 7. Inspected an office building, built and equipped by Dr. Marinho, a nose, throat and ear specialist, as his exclusive office work-shop. The building is four stories in height, and about twenty by thirty feet in area. An elevator connects all floors. The building is utilized as

follows: First floor—reception room with office attendant, and recording room; second floor—clinic for people who can pay nothing or very little, fully equipped with several stalls where he and his assistants work several hours in the morning of each day; third and fourth floors—offices for private patients and extensive laboratories; fifth floor—an assembly room, with projectoscopes, lanterns, and other equipment for teaching and demonstrating to groups. The building occupies a site in the center of the business section of the city. It is constructed of stone, steel, and glass, and contains the latest type of modern office equipment imported from Europe and America. The builder of this palace workshop is a charming man, and is one of the distinguished teachers in the Faculty of Medicine. He is about forty-five years of age, full of enthusiasm, and devoted to his work. He speaks some English, and has promised to visit the United States.

At 11 o'clock, Mrs. Martin and I decided to take another trip to Corcovado. We went by the San Silvestre tram and climbed from there to Paineiras by cog. On the terrace of the hotel, overlooking the sea in the direction of the Country Club, we had our luncheon and feasted our eyes. After walking a mile by the old aqueduct, we went to the top of Corcovado. In this instance it was cloudless.

At 5 o'clock of this same day we were the guests of the Mendonças and the Clarks at the Rio de Janeiro Athletic Club, the Fluminense. It is a club of great beauty at the mountain base in the fashionable residence portion of the city, adjoining the Emperor's old palace, the grounds of which portions of it overlook. It contains a foot-ball field, tennis courts, buildings with billiard and card rooms, dining rooms, ball rooms, libraries, and bowling alleys. There is also a large swimming pool, with a canopy top and balconies for spectators. Fresh salt-water from the sea is constantly pumped into the great tile-lined tank.

At 8:30 in the evening our party of five dined with Ambassador Morgan at the Country Club. There were sixteen at dinner. Mr. Morgan is an ideal host and is to be envied in his position. He has gathered about himself a delightful court from the English speaking colony and is equally popular in Brazilian circles.

April 8. Dinner with Dr. and Mrs. Pyles at the Jockey Club. The Crowells, Mr. Gade, the Swedish Ambassador, and his wife and a number of others were present. Mrs. Pyles is an exceedingly attractive woman and a charming hostess. Dr. Pyles' father was a Virginian who migrated to Brazil with a number of southerners after our Civil War. Dr. Pyles was born in Brazil, but received his education in the United States. He is devoted to his profession of surgery and to the Brazilians.

23. Embarking on the SS. Vauban

April 9. And now, with sadness and regret, we have come to the end of this holiday that has had so much of profit and pleasure in it. We were driven to the SS. Vauban at noon, preparatory to sailing at 4 o'clock; but previous to this, that our last day might be punctuated by the business in hand, we went with Dr. Clark to witness an operation for nephrectomy under local anæsthesia by Dr. Mendonça. Everything passed off according to schedule, and we were more than ever filled with admiration for the graciousness and skill of this great Brazilian surgeon.

At 2 o'clock, as we looked out from the deck of the ship, the Mendonças and the Clarks appeared, and in the arms of the ladies and the chauffeur were great bouquets of flowers for Mrs. Watkins and Mrs. Martin which fairly filled our staterooms. Mr. Morgan brought us magazines, Dr. Ramos, Dr. de Castro and Dr. Marinho came to say adieu, and at the last hour came Dr. Olympia da Fonseca, the Secretary of our Committee on Credentials, with his greetings and a substantial package which contained the applications for Fellowship in the College of the seven members of the committee, duly signed and approved, each with a draft pinned to it covering the membership entrance fee. A list of a number of candidates, including a group from Bahia, will follow.

The bell tolled, final goodbyes were said, and the curtain slowly descended on a great scene of a great drama.

Retrospect

This is my second visit to the South American countries. Some one in Argentine asked me why I came back. Some one in Brazil has asked me if I shall return to this country. One visits these countries for the first time in a spirit of adventure, because one has in one's vision great countries in our own southern continent where new things will be found, where new beauties will be appreciated, and where a people of a new world will be building a new empire upon a prehistoric empire; where the southern cross will give a new standpoint from that of the polestar, and where one can spend a profitable holiday away from the snow and frost of home, in a land of warmth and sunshine.

One visits these countries a second time not in a spirit of adventure and exploration but in a spirit of friendship—friendship for its civilization; friendship for a people of old Portugal and Spain, recreated by decades of transition on the lands of a southern America to a strong race of loving, competent people; friendship for a people who take time to be polite, to gain culture, to cultivate the arts, and to learn the languages of the world. One comes to get relief from the sordid hustle and bustle of a too practical country, and to drink in some of the wine of repose and vision that is possessed by these Americans of the South.

And so, life being spared, we will come again and again. When we are away in our own great land and at our work, we shall profit by our memories of the artistic people of the land of sunshine, and shall know that we have friends with warm hearts and glad eyes waiting to give us the hearty handclasp of welcome another year. We will come because we admire their great countries and because we have learned to love their people.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

Eleventh Annual Session, Philadelphia, October 24-28, 1921

GEORGE E. ARMSTRONG, Montreal, *President*
JOHN B. DEAVER, Philadelphia, *President-Elect* ALBERT J. OCHSNER, Chicago, *Treasurer*
FRANKLIN H. MARTIN, Chicago, *Secretary-General*

THE CLINICAL CONGRESS IN PHILADELPHIA

THE eleventh annual session of the Clinical Congress of the American College of Surgeons will be held in Philadelphia during the last week of October of this year, this being the third session of the Congress to be held in that city. The session will open with the presidential meeting on Monday evening, and following the general plan of previous sessions, the morning and afternoon hours of the succeeding four days will be devoted to operative clinics and demonstrations in the hospitals and medical schools with scientific meetings each evening in the ballroom of the Bellevue-Stratford.

A committee of Philadelphia surgeons, headed by Dr. George P. Muller, Chairman, and Dr. Damon B. Pfeiffer, Secretary, is actively engaged at this time in developing a program of clinics and demonstrations that will fully represent the clinical activities of that great medical center. In this program all departments of surgery will be represented, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc.

General headquarters for the Congress will be at the Bellevue-Stratford Hotel where the entire first floor has been reserved for the use of the Congress. The large ballroom will be utilized for the evening sessions and for certain clinical demonstrations in the mornings and afternoons. The Clover, Red, Green, and other large rooms and foyers on the same floor will be utilized for registration and ticket bureaus, bulletin rooms, etc.

The annual business meeting of the American College of Surgeons and the Clinical Congress will be held on Thursday afternoon at 3 o'clock in the ballroom of the Bellevue-Stratford.

At the ninth convocation of the American College of Surgeons, to be held in the ballroom on Friday evening at 8 o'clock, fellowship in the College will be conferred upon a large group of American and Canadian surgeons, and at the same time honorary fellowships will be conferred upon the distinguished foreign guests.

It is expected that the railways will grant a substantial reduction in fares for the Philadelphia meeting, an application therefor being pending before the Trunk Lines Association. Detailed information with regard to fares and traffic arrangements will be published in later issues.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting the attendance, requiring registration in advance on the part of those who wish to attend. A survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools, as to their capacity for accommodating visitors, will be made and the limit of attendance based thereon. This plan insures accommodations at the clinics for all who register in advance, and the necessity for adopting such a plan will be apparent to all. Based upon our experience at previous meetings, it is probable that the limit of attendance will be reached weeks in advance of the meeting, hence the necessity for early registration, for when the limit of attendance has been reached through advance registration, no further applications can be accepted.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic being

limited to the capacity of the room in which the clinic is to be given. The use of clinic tickets has proven an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding.

Tickets will be issued each morning at 8 o'clock for that day's clinics, except that for Tuesday's clinics the tickets will be issued Monday afternoon.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, the receipts from such fees providing the funds with which to meet the expenses of conducting the meeting, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

STATE CLINICAL MEETINGS

Meetings of state sections of the Clinical Congress of the American College of Surgeons were held during April for the state of Ohio at Cleveland, April 1 and 2; for New Jersey at Newark, April 11 and 12; for Virginia at Richmond, April 14 and 15; for West Virginia at Wheeling, April 18 and 19; for Michigan at Detroit, April 28 and 29. At each meeting there were clinical, scientific, and public sessions, and a hospital conference on standardization. The programs follow.

OHIO

FRIDAY, APRIL 1

Clinics

At the Charity, City, Huron Road, Lakeside, Maternity Mt. Sinai, St. Alexis, and St. Ann's Hospitals, 9 a.m. to 12 m.

Scientific Session, 2 p.m.

Charles S. Hamilton, M.D., Chairman, Ohio State Section, Presiding.

The Diagnosis and Management of Small Renal and Uretral Calculi—Hugh Cabot, M.D., Ann Arbor.

Restoration of the Obliterated Eye Socket—John W. Wheeler, M.D., New York.

Hospital Conference, 3:30 p.m.

Walter H. Snyder, M.D., Presiding.

The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—George W. Crile, M.D., Cleveland.

Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—Frank E. Chapman, Superintendent, Mt. Sinai Hospital, Cleveland.

Discussion—Opened by C. D. Selby, M.D., Toledo.

Public Meeting, 8:30 p.m.

Charles S. Hamilton, M.D., Chairman, Presiding.

Address of Welcome—Hon. James Garfield.

Public Health, a Community Responsibility—Hugh Cabot, M.D., Ann Arbor.

The Importance of Goiter Being Recognized by the General Public—Willard Bartlett, M.D., St. Louis.

Program of the American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

SATURDAY, APRIL 2

Clinics

At the Charity, City, Huron Road, Lakeside, Maternity, Mt. Sinai, St. Alexis, and St. Ann's Hospitals, 9 a.m. to 12 m.

Scientific Session, 3 p.m.

A Contribution to the Subject of Local Anæsthesia—Willard Bartlett, M.D., St. Louis.

Essential Neuralgia of the Fifth Cranial Nerve (Tic Douloureux)—Lyndon Holt Landon, M.D., Pittsburgh, Pa.

NEW JERSEY

MONDAY, APRIL 11

Clinics

At the Newark City, St. Michael's, St. Barnabas', St. James', Newark Memorial, Presbyterian, Beth Israel, Newark Private, and Babies' Hospitals; Newark Eye and Ear Infirmary; and Home for Crippled Children, 8 a.m. to 12:30 p.m.

Hospital Conference, 2:30 p.m.

Walter B. Johnson, M.D., Chairman, New Jersey State Section, Presiding.

The Hospital Program of American College of Surgeons and the Meaning of the Minimum Standard—Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Program of the American College of Surgeons as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.

Experience with Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—John C. Moody, M.D.

Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—Mr. Thomas R. Zulich, Superintendent, Paterson Hospital.

Discussion—Opened by Philander A. Harris, M.D., Paterson, N. J.

Public Meeting, 8:30 p.m.

Hon. William N. Runyon, State Senator, Presiding.
The American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
What the Surgeon is Doing to Limit the Necessity for Operation—Robert L. Dickinson, M.D., New York.
The Work of the American Society for the Control of Cancer—Howard C. Taylor, M.D., New York.
The Medical Profession and the Legal Profession—Edward M. Colie, Esq.
The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.

TUESDAY, APRIL 12

Clinics

At the Newark City, St. Michael's, St. Barnabas', St. James', Newark Memorial, Presbyterian, Beth Israel, Newark Private and Babies' Hospitals; Newark Eye and Ear Infirmary; and the Home for Crippled Children, 8. a.m. to 12:30 p.m.

Scientific Session, 2:30 p.m.

Walter B. Johnson, M.D., Chairman.
Operations in Previously Nephrectomized Patients—George N. Sommer, M.D., Trenton, N. J.
The Operative Indications in the Cure of Retroversion and Prolapse—Robert L. Dickinson, M.D., New York.
Can Prostatic Symptoms Be Postponed?—Ellis W. Hedges, M.D., Plainfield, N. J.
The Use of Radium in Gynecology—Howard C. Taylor, M.D., New York.
General Discussion.

VIRGINIA

THURSDAY, APRIL 14

Clinics

At the St. Luke's Memorial, St. Philip's and the Dooley Hospitals; the Johnston-Willis Sanitarium; and the Retreat for the Sick, 9 a.m. to 1 p.m.

Hospital Conference, 2:50 p.m.

A. Murat Willis, M.D., Chairman, Virginia State Section, Presiding.
The Hospital Program of the American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
The Soul of Standardization—Rev. C. B. Moulinier, S.J., President of Catholic Hospital Association.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—A. Murat Willis, M.D., Richmond.
Experience with the Standardization Program of the American College of Surgeons from the Standpoint of a Medical Director of a Hospital—C. C. Coleman, M.D., Richmond.
Discussion—Opened by H. H. Trout, M.D., Roanoke.

Public Meeting, 8 p.m.

A. Murat Willis, M.D., Chairman.
Invocation—Rev. W. Russell Bowie, D.D.
Address—Hon. Harry St. George Tucker.
The American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Surgeon's Problems in Relation to the Public—Dean Lewis, M.D., Chicago.
The Early Recognition of Cancer and Its Importance—Charles A. Hamann, M.D., Cleveland.
The Standardization of Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.
Address—Douglas Freeman, Ph.D., Editor of News-Leader, Richmond.

FRIDAY, APRIL 15

Clinics

At the Grace Stuart Circle, St. Elizabeth's, Memorial, St. Philip's and the Dooley Hospitals, 9 a.m. to 1 p.m.

Scientific Session, 2:50 p. m.

A. Murat Willis, M.D., Chairman.
Traumatic Chylothorax—Stephen H. Watts, M.D., University of Virginia.
The Relation of the Medical Profession to the Public—Victor C. Vaughan, M.D., University of Michigan.
The Treatment of Ununited Fractures—Dean Lewis, M.D., Chicago.
Clinical Resemblances between Inflammatory Processes and Neoplasms—Charles A. Hamann, M.D., Cleveland.
A Consideration of Hydatidiform Mole and the Incidence of Associated Malignancy—R. L. Payne, M.D., Norfolk, Va.

WEST VIRGINIA

MONDAY, APRIL 18

Clinics

At the Wheeling and the Ohio Valley General Hospitals, 9 a.m. to 12 m.

Hospital Conference, 2 p.m.

John E. Cannaday, M.D., Chairman, West Virginia State Section, Presiding.
The Standardization Program of the American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Program of the American College of Surgeons as Applied to Catholic Hospitals—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons from the Surgeon's Standpoint—John E. Cannaday, M.D.
Experience with the Standardization Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—J. Ross Hunter, M.D., Huntington.
Discussion—Opened by Frank L. Hupp, M.D., Wheeling.

Public Meeting, 8 p.m.

John E. Cannaday, M.D., Chairman.
Address of Welcome—Judge Frank W. Nesbitt, Wheeling.
The American College of Surgeons—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

The Relation of the Public to Medical Progress—William E. Lower, M.D., Cleveland.
The Work of the American Society for the Control of Cancer—Howard C. Taylor, M.D., New York.
Factors in the Control of Cancer—Frank L. Hupp, M.D., Wheeling.
The Standardization of Hospitals—Rev. C. B. Moulinier, S. J., Milwaukee.

TUESDAY, APRIL 19

Clinics

At the Wheeling and Ohio Valley General Hospitals, 9 a.m. to 12 m.

Scientific Session, 2 p.m.

John E. Cannaday, M.D., Chairman.
Hernial Protrusions of the Pelvic Outlet—Gregory Ackerman, M.D., Wheeling.
The Diagnosis and Treatment of Tumors of the Urinary Bladder—William E. Lower, M.D., Cleveland.
The Use of Radium in Gynecology—Howard C. Taylor, M.D., New York.
The Physiological Factors in Brain Injuries and Their Practical Importance—J. Schwinn, M.D., Wheeling.
Review of Clinics—J. Ross Hunter, M.D., Huntington, and Wade H. St. Clair, M.D., Bluefield.

MICHIGAN

THURSDAY, APRIL 28

Clinics

At the Children's Free, Ford, Grace, Harper, Herman Kiefer, Michigan Mutual, Providence, Receiving Samaritan, St. Mary's, and Woman's Hospitals, 9 a.m. to 12 m.

Hospital Conference, 2:30 p.m.

Reuben Peterson, M.D., Chairman, Michigan State Section, Presiding.
The Meaning of the Minimum Standard—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Minimum Standard as Applied to Catholic Hospitals—Rev. C. B. Moulinier, S.J., President of the Catholic Hospital Association.
The Work of the Hospital Surveyor—Frederick W. Slobe, M.D., Hospital Survey Department, American College of Surgeons.
The Hospital Program of the American College of Surgeons from the Hospital Superintendent's Standpoint—Warren L. Babcock, M.D., Grace Hospital, Detroit.
The Hospital Program of the American College of Surgeons from the Surgeon's Standpoint—Richard R. Smith, M.D., Grand Rapids.
Discussion—Opened by F. C. Warnshuis, M.D., Grand Rapids.

Public Meeting, 8 p.m.

Reuben Peterson, M.D., Presiding.
Address of Welcome—Honorable James Couzens, Mayor of Detroit.
The American College of Surgeons—Franklin H. Martin, M.D., Chicago, Secretary-General, American College of Surgeons.
How the Public Can Assist in Reducing the Mortality of Cancer—Allen B. Kanavel, M.D., Professor of Surgery, Northwestern University Medical School.
Human Salvage—Harry E. Mock, M.D., Assistant Professor of Industrial Medicine and Surgery, Rush Medical College of Chicago.
The Standardization of Hospitals—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
Better Hospitals—Rev. C. B. Moulinier, S. J., President of the Catholic Hospital Association.
The Surgeon in a Larger Field of Service—Rev. Samuel Marquis, D.D.

FRIDAY, ARRIL 29

Clinics

At the Children's Free, Ford, Grace, Harper, Herman Kiefer, Michigan Mutual, Providence, Receiving Samaritan, St. Mary's, and Woman's Hospitals, 9 a.m. to 12 m.

Scientific Session, 2:30 p.m.

Reuben Peterson, M.D., Chairman.
The Diagnosis and Treatment of Small Renal and Ureteral Calculi—Hugh Cabot, M.D., Ann Arbor, Professor of Surgery, University of Michigan Medical School.
Surgery of the Hand—Allen B. Kanavel, M.D., Chicago.
Reconstructive Surgery—Illustrated by Cases of (a) Congenital Absence of Arms; (b) Temporal Maxillary Ankylosis; (c) Osteomyelitis; (d) Back Injury—Harry E. Mock, M.D., Chicago.

MEETINGS TO BE HELD

Wisconsin—June 17 and 18.
Minnesota—June 20 and 21.
North Dakata—June 24 and 25.
South Dakota—June 27 to 28.

CORRESPONDENCE

AN AID IN THE EARLY DIAGNOSIS OF ACUTE APPENDICITIS

To the Editor: The objective symptoms of acute appendicitis are so well known that to mention a sign new to me I trust may not seem presumptuous. It is generally conceded that the danger of certain types of acute appendicitis is great, but also it must be admitted that the exact degree of inflammation is better known after than before operation. How natural it is for the family physician to be influenced by the patient's abhorrence of operation and wait for the development of rigidity and marked point pressure tenderness before forcing the issue of operation, in the meantime trusting to the ice bag and nature. Too often the surgeon finds such cases ruptured at time of operation, thus sometimes placing the patient's life in jeopardy and always making for a prolonged stay in the hospital on account of the necessary drainage, followed by the possibility of weakened abdominal wall and greater probability of adhesions. This is particularly true in the acute cases of deeply situated appendices when at the onset the peritoneal reflexes are mild or absent. I find that by placing the tip of the middle finger in constant contact with the abdomen at McBurney's point and using the wrist to produce perpendicular vibratory movements, the vibratory wave stream thus transmitted through the finger tip will penetrate to a great depth, and cause marked peritoneal reflexes and exquisite pain some time before the commonly known symptoms of point pressure tenderness and rigidity are manifest. And with subjective symptoms of acute appendicitis and the vibratory sign present, operation will disclose an appendix requiring early intervention. I feel that more cases of acute appendix will come to operation before rupture if this method of examination is kept in mind.

E. P. Porter, A.B., M.D.
Attending Gynecologist, Swedish Hospital

Brooklyn

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Leitfaden fuer den geburtshilflichen Operationskurs. By Dr. med. et Dr. art. obs. h. c. Albert Doederlein. 13th ed. Leipzig: Georg Thieme, 1921.

Mother and Child. By Edward P. Davis, A.M., M.D. 4th ed. Philadelphia: J. B. Lippincott Co., 1921.

Gli apparecchi Ortopedici. By F. Delitala. Bologna: L. Cappelli, 1921.

La Cisticercosi Cerebrale. By G. Forni. Bologna: L. Cappelli, 1921.

Tuberculosis in Children; Its Diagnosis and Treatment. By Professor Dr. Hans Much, Translated by Dr. Max Rothschild. New York: The Macmillan Co., 1921.

General Practice and X-Rays. By Alice Vance Knox, M.B., B.Ch. With chapters on the production of X-rays and instrumentation by Robert Knox, M.D., C.M., M.R.C.S., L.R.C.P. London: A. & C. Black, Ltd., New York: The Macmillan Co.

Birth Statistics for the Birth Registration Area of the United States, 1919. Fifth Annual Report. Washington: Government Printing Office, 1921.

Diagnostik und Therapie der Knochen- und Gelenktuberkulose; mit besonderer Beruecksichtigung der Theorie und Praxis der Sonnenbehandlung. By Dr. med. Eugen Kisch. Leipzig: F. C. W. Vogel, 1921.

Transactions of the American Gynecological Society. Vol. xlv, 1920. Edited by George Gray Ward, Jr., M.D. Philadelphia: Wm. J. Dornan, 1920.

Injuries and Diseases of the Bones and Joints; their Differential Diagnosis by Means of the Roentgen Rays. By Frederick H. Baetjer, M.D., and Charles A. Waters, M.D. New York: Paul B. Hoeber, 1921.

Notions pratiques d'Electrothérapie appliquées a l'urologie. By Docteur Denis Courtade. 2d ed. Paris: Librairie E. le François, 1921.

Traumatic Surgery. By John J. Moorhead, B.S., M.D., F.A.C.S. 2d ed. Philadelphia and London: W. B. Saunders Company, 1921.

Surgery of the Upper Abdomen. By John B. Deaver, M.D., Sc.D., LL.D., F.A.C.S., and Astley Paston Cooper Ashhurst, A.B., M.D., F.A.C.S. 2d ed. Philadelphia: P. Blakiston's Son & Co., 1921.

Functional Diagnosis. By Max Kahn, M.A., Ph.D., M.D. New York: W. F. Prior Company, 1921.

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